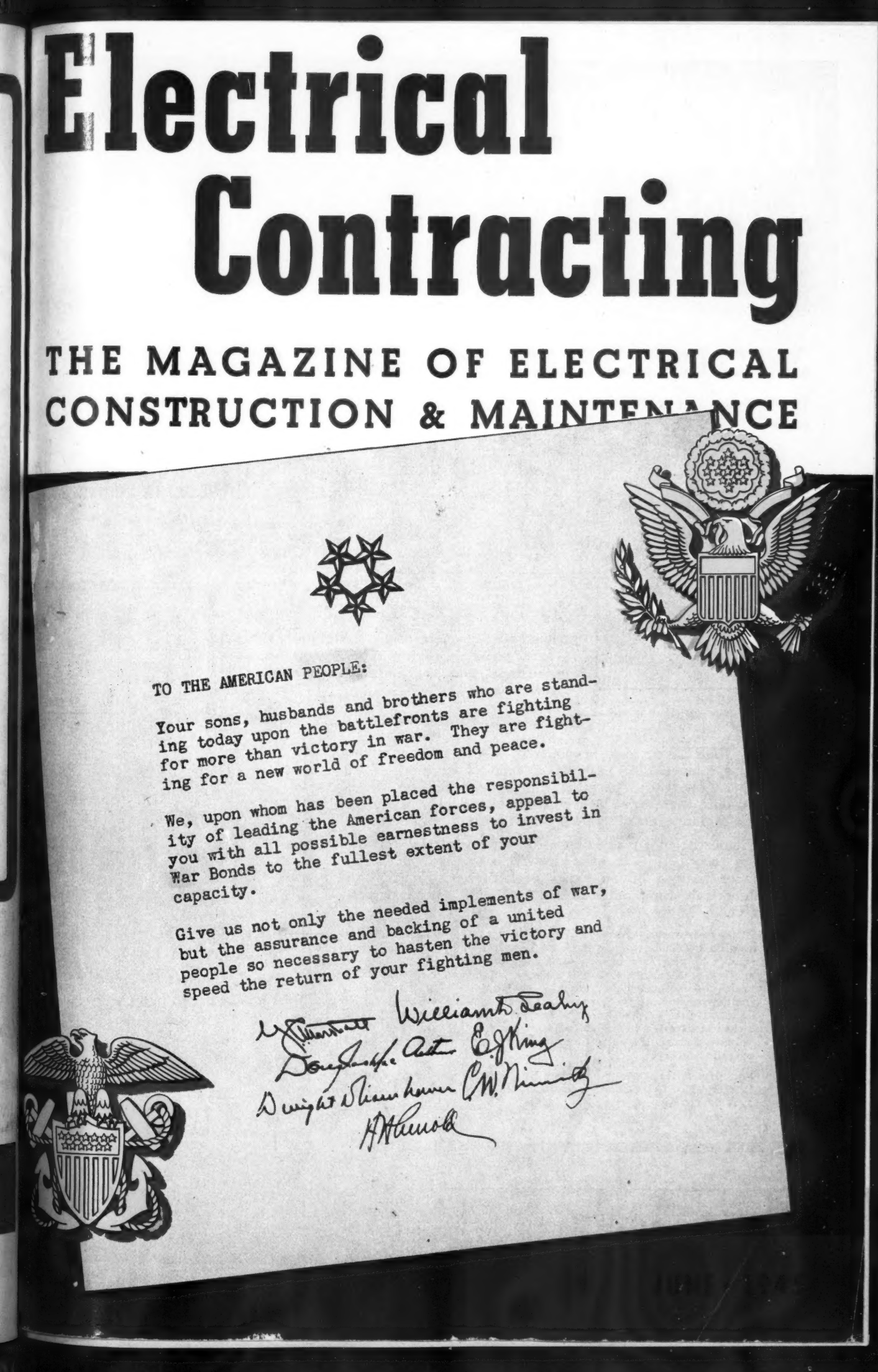
Electrical Contracting

THE MAGAZINE OF ELECTRICAL CONSTRUCTION & MAINTENANCE



TO THE AMERICAN PEOPLE:

Your sons, husbands and brothers who are standing today upon the battlefronts are fighting for more than victory in war. They are fighting for a new world of freedom and peace.

We, upon whom has been placed the responsibility of leading the American forces, appeal to you with all possible earnestness to invest in War Bonds to the fullest extent of your capacity.

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Ernest J. King
Dwight D. Eisenhower
Chester W. Nimitz
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16,000,000 G-E ballasts have been installed since 1938 ... 99.5 per cent are still going strong

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G-E ballasts are a powerful sales feature to add to your product.

FLUORESCENT-FIXTURE BUYERS:

Ballasts are an important component. Specify G-E —to help assure good performance, negligible maintenance, and long life of your fluorescent installations.

HERE'S a recent report from a Midwestern bomber plant: "The 12,000 G-E ballasts we installed in 1942 have been operating round-the-clock ever since. To date there have been only six electrical failures." A performance record 99.99 per cent perfect!

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A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management, in the field of electrical construction and maintenance.

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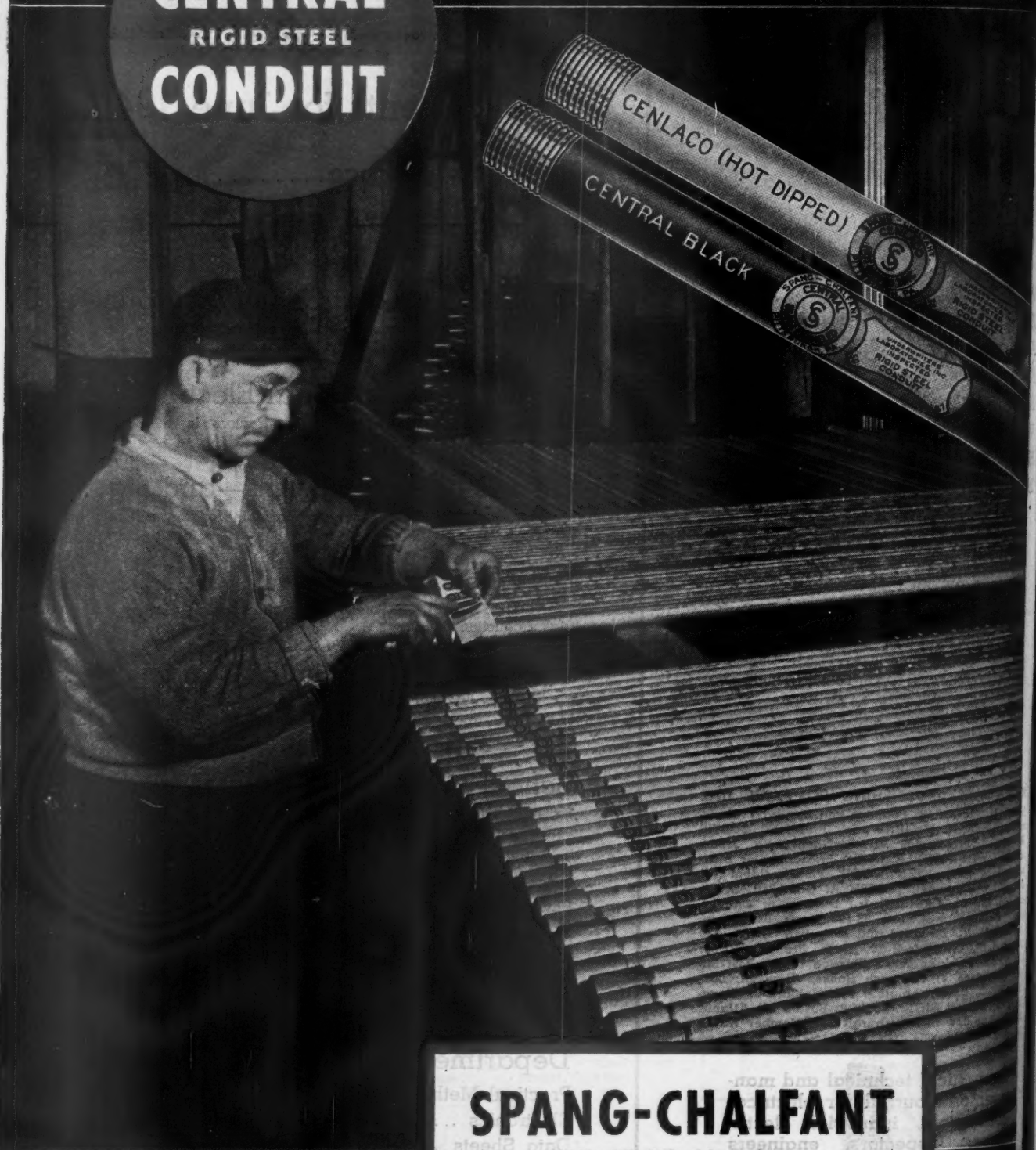

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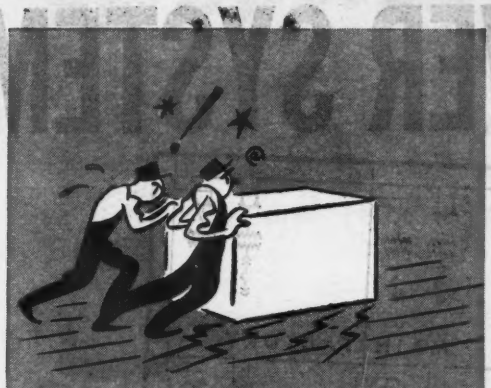
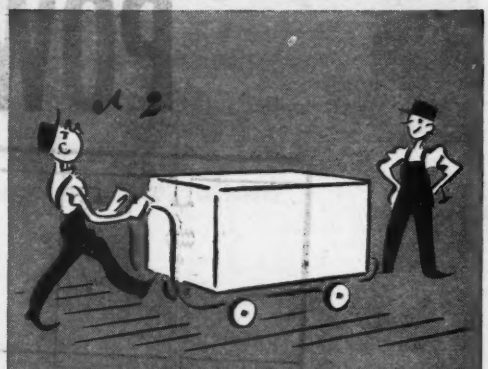
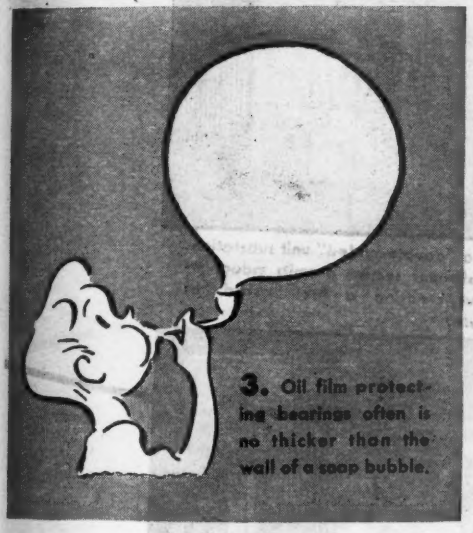


1. Like a motor without oil. Simple! Yet every day hundreds of workers overlook the importance of adequate motor lubrication.

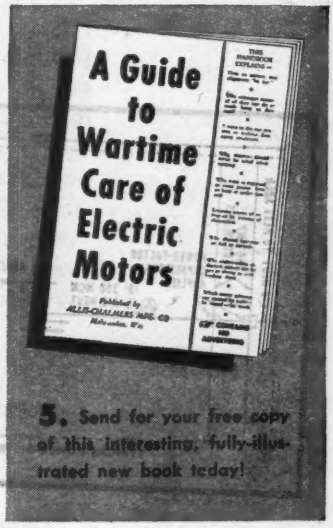


2. Like a motor with oil. Pictures like these make motor maintenance easy to put across in training new employees.



3. Oil film protecting bearings often is no thicker than the wall of a soap bubble.

4. And if pressure is too great, the film can fail just as suddenly and completely.



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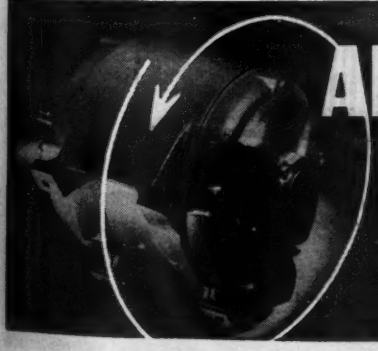

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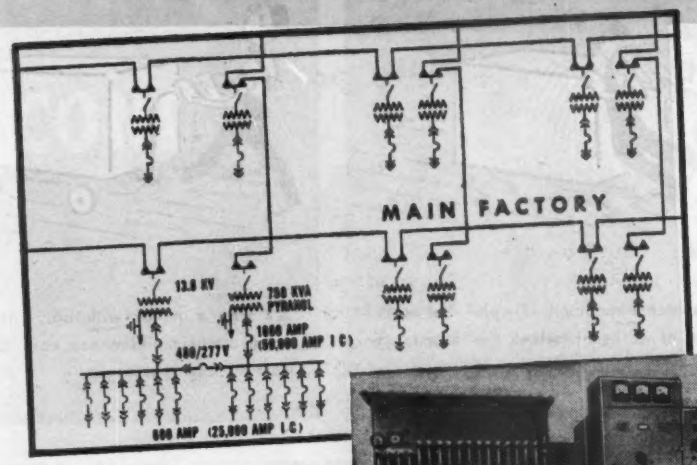
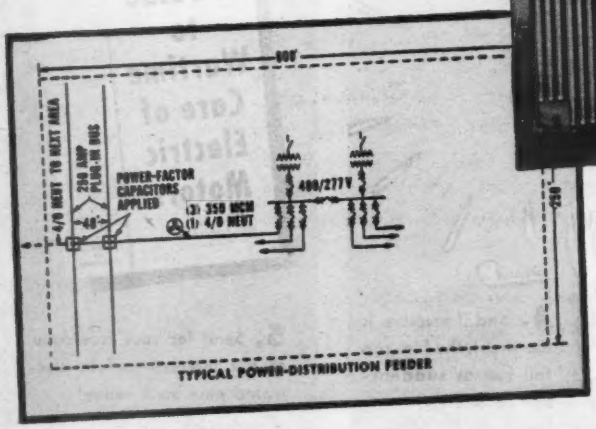
AC WE WORK FOR VICTORY WE PLAN FOR PEACE

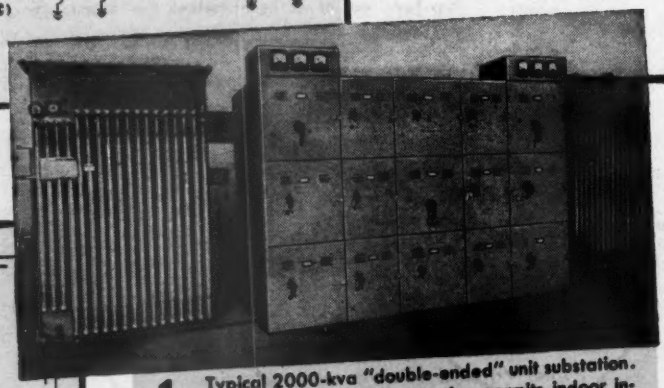
This War-Plant POWER SYSTEM HAS





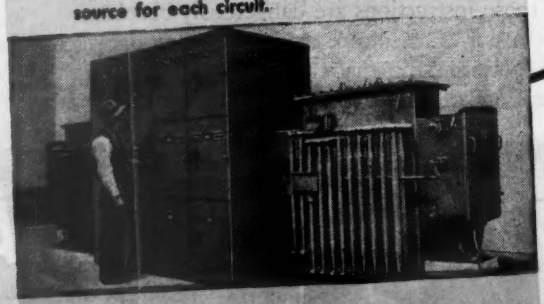
(Upper chart) A section of the "one-line diagram" for the main factory area, where 16 unit substations aggregating 30,000 kva are installed.

(Lower chart) "Close-up" of factory area served by one substation, showing 40-ft spacing of plug-in bus. Note that one substation serves 150,000 sq ft.



1. Typical 2000-kva "double-ended" unit substation. A Pyranol* transformer section permits indoor installation without creating a fire hazard, as Pyranol can't burn.

6. A 5000-kva unit substation serving heavy-demand area, with two sections mounted face to face. A tie breaker between the two gives a second power source for each circuit.



7. One of four 200-kva units serving the office area and basement, conveniently located in "penthouses" above the load centers.

*Trade-mark reg. U.S. Pat. Office

GE

LOAD-CENTER
Power Distribution Systems

LL Strong Points

Designed to save on materials and manpower, this load-center installation has made an unusual operating record for safe and reliable power distribution.

1 Load-center unit substations are employed throughout in a *secondary selective* arrangement. The two primary feeders to every substation start from different 13.8-kv buses. Every load circuit is backed up by two independent sources of power. Yet all equipment normally shares in carrying total load. All necessary immediate switching to maintain power supply can be done at 480 volts.

2 Primary distribution at 13.8 kv is handled by 3-conductor feeder cables carried in overhead troughs. Overhead installation saved manpower and materials. Inspection and relocation of cables are easy.

3 480 Y/277-volt secondary circuits serve local load-areas by means of plug-in bus. As substations are installed on the building roof, feeder taps to each plug-in bus are short and direct.

4 Fluorescent lighting of factory area is supplied from the same unit substations which serve factory operation. The 277-volt operation of lights from the line-to-neutral conductors of the system is highly economical, as compared with 120- or 208-volt circuits.

5 Capacitors, applied close to the machine-tool motor load, add to the carrying capacity of the substations. They are ceiling-mounted in blocks of 90-kva at the feeder taps of the plug-in bus throughout the main factory area. (10,000 kva, total).

6 Areas of heavy demand, requiring motors of 250 hp and larger, are served by separate substations which convert from 13.8 to 2.4 kv, again using the secondary-selective principle. Within these areas, small motor and lighting loads are powered by "sub-substations" which have 2.4-kv primary and 480/277-volt secondary.

7 An extensive office-building area is served by unit substations having secondary circuits at 208/120 volts.

POWER SYSTEMS LIKE THIS protect operating continuity and give any plant greater flexibility to meet changing needs. They can be applied to old plants as a complete modernization project, or step by step without interrupting production. The over-all installed cost is fully predictable.

G-E application engineers will be glad to give you recommendations based on highly successful wartime installations. *General Electric Company, Schenectady 5, N. Y.*

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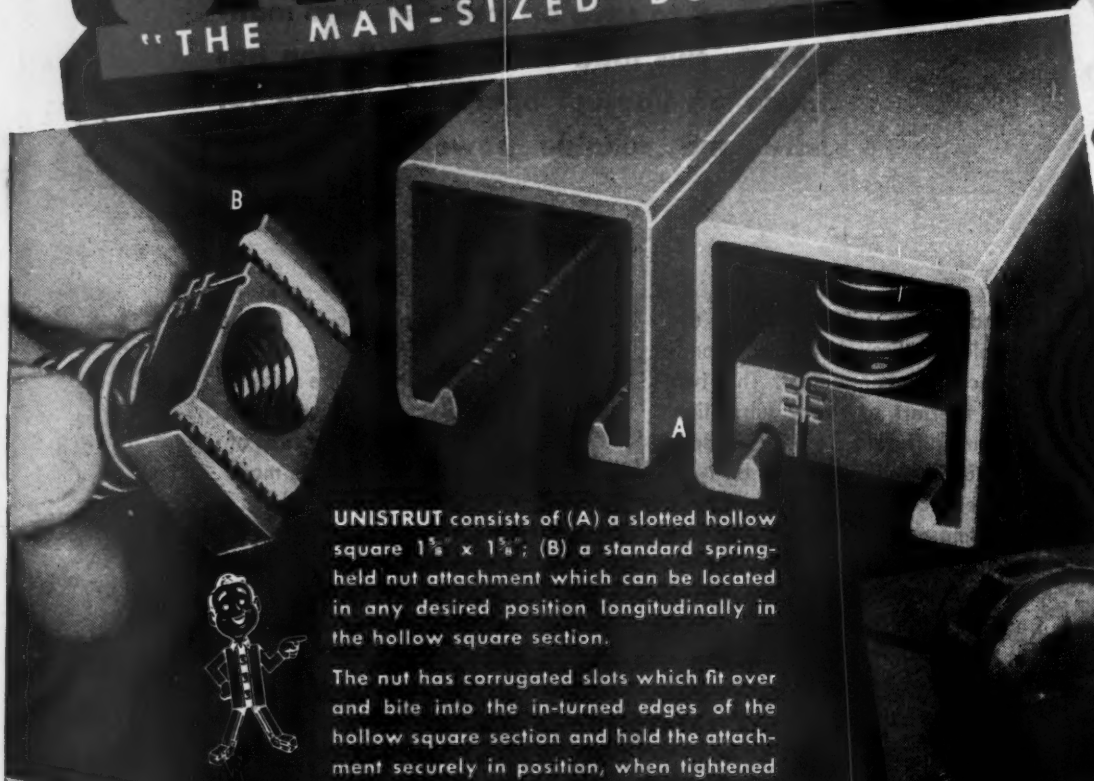
"THE MAN-SIZED BUILDING SET"

Build 'em 1-2-3, with a Hack Saw, Wrench and Slotted Hollow-Square UNISTRUT.

1. **CUT UNISTRUT** to length desired with a hack saw.
2. **LOCATE** fitting and nut at proper point.
3. **BOLT** securely with a turn of the wrench.



UNISTRUT consists of (A) a slotted hollow square 1⅝" x 1⅝"; (B) a standard spring-held nut attachment which can be located in any desired position longitudinally in the hollow square section.

The nut has corrugated slots which fit over and bite into the in-turned edges of the hollow square section and hold the attachment securely in position, when tightened with an ordinary wrench.

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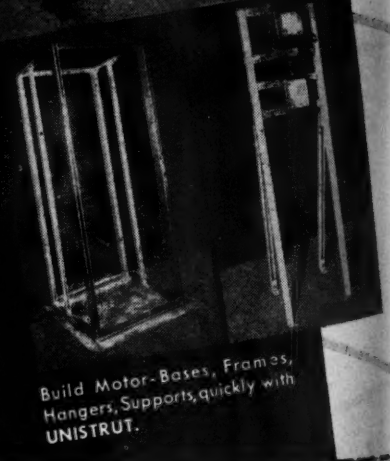
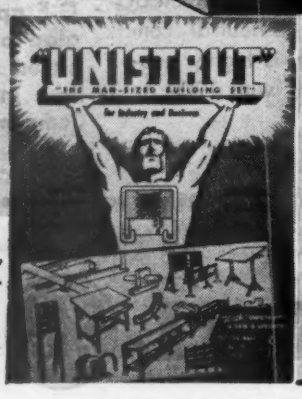


Build Motor-Bases, Frames, Hangers, Supports, quickly with UNISTRUT.



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Send for catalog that gives you full information on the advantages of this automatic control and describes our complete line of types.

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Contractors right now have installation opportunities by selling SANGAMO TIME SWITCHES to floodlighting users who are without this automatic control.

• There are types to meet every protective lighting control need. The complete line includes Astronomic Dial, Synchronous Carry-Over, and Outdoor Time Switches. Form VSWZ Astronomic Dial Time Switch is shown above. Current interruptions up to 10 hours will not stop it nor affect its "on" and "off" settings.

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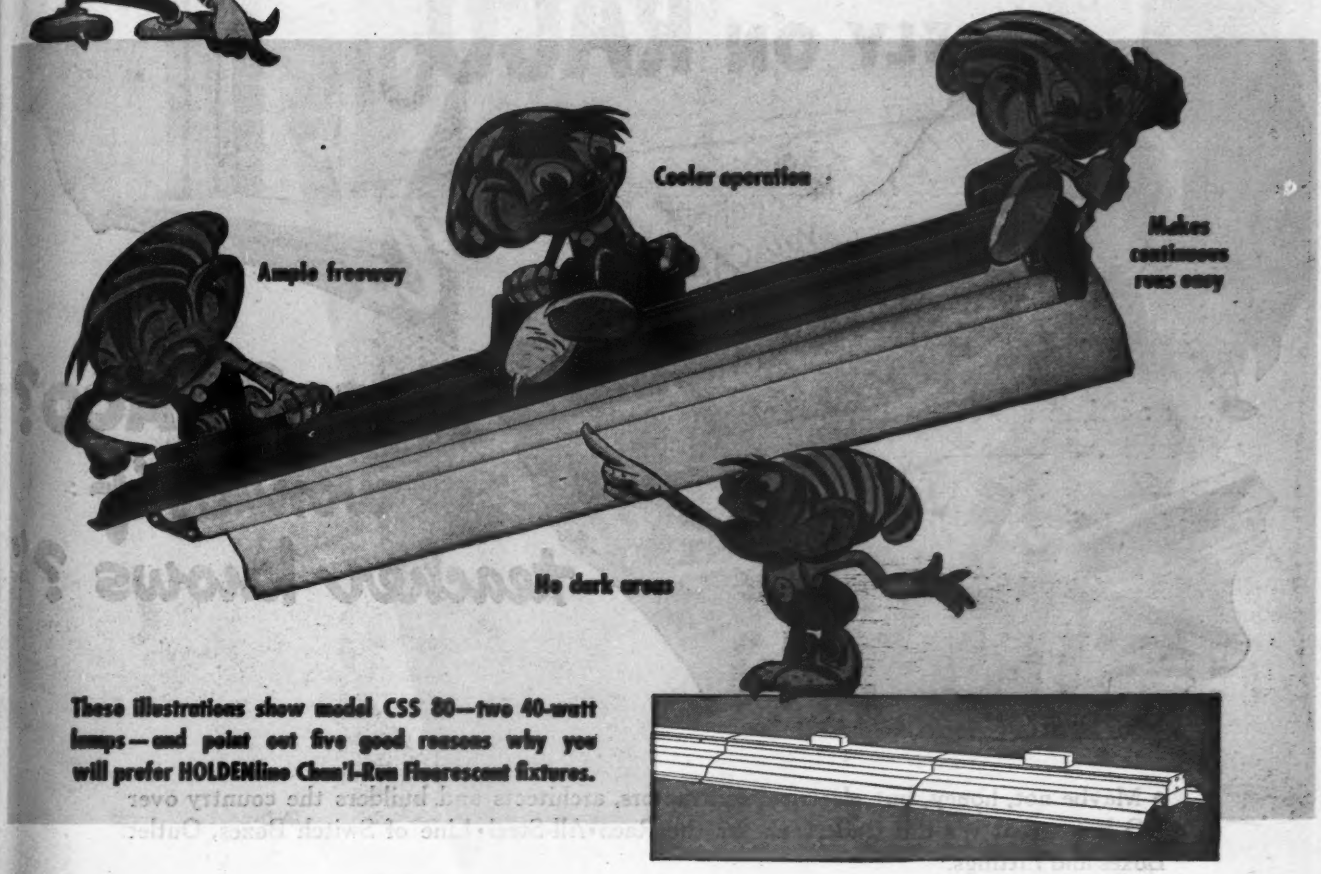
SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

For your new fixtures specify

HOLDENLINE CHAN'L-RUN



These illustrations show model CSS 80—two 40-watt lamps—and point out five good reasons why you will prefer HOLDENline Chan'l-Run Fluorescent fixtures.

- **Removable end cap** permits swift change to continuous run using standardized units. Takes 3 minutes to convert! Individual units or continuous run from one basic unit. Nothing needed but a screw driver.
- **Exposed ballasts** mean cooler operation, longer condenser life —fewer replacements.
- **2½" spacing** between lamps—no dark areas.
- **Ample freeway to pull wires through channel** when changing to, or installing, continuous run—saves time and money.
- **Sturdy butt-on sockets** mounted on heavy steel prevent socket breakage—lamps always held firmly.

Rapid and simple is the conversion to continuous run—on all Chan'l-Run units. Socket spacing always positive.

Other units available are
CSS-85, 2-lamp 40-watt, 3" lamp spacing
CSS-120, 3-lamp 40-watt
CSS-200, 2-lamp 100-watt, 45" lamp spacing

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Pioneers in Fluorescent

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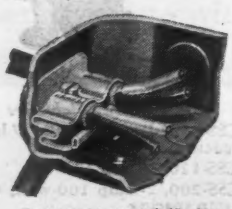
WHY RACO IS YOUR "BEST BET"

It's *clean*—There's always a smooth, lustrous finish on Raco•All-Steel•Products. No jagged or rough edges. No dirt or grease.

It's *packaged*—The Raco line comes to you in good-looking, neat cartons . . . cartons that have a readable index showing product number, quantity and finish.

It's *uniform*—The same exacting standards are used in the Raco line that have been outstanding in All-Steel's precision metal products for over 32 years.

Also, *Raco•All-Steel* is *sold nationally* through *wholesalers only*. It's the quality line, your dependable line. Look for the Raco trademark . . . your sign of better workmanship.



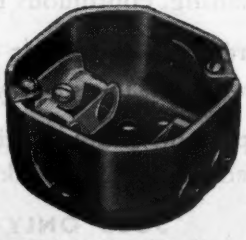
DO-21-N-3 3½" dia.
DO-16-N-3 4" dia.

Use Raco clamp type boxes to solve many of your connector worries.

DO-21-N-3, 3½" dia. is widely used with non-metallic cable.

DO-30-N, 3½" dia. is the perfect box for use with "BX."

ALL-STEEL-EQUIP COMPANY, INC.
600 Kensington Avenue, Aurora, Illinois



DO-30-N 3½" dia.
DO-31-N 4" dia.

RACO • ALL-STEEL • PRODUCTS
SWITCH BOXES • OUTLET BOXES • CONDUIT FITTINGS

PANTHER
BLACK
BLACK
DRAGON
SPECIFICATION FRICTION TAPE
HAZARD INSULATED WIRE WORKS
THE OKONITE COMPANY
3/4
DRAGON
Sold through recognized
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HAZARD INSULATED
WIRE WORKS
ARMY
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Division of The Okonite Company
Wilkes-Barre, Pennsylvania
PANTHER
& DRAGON
FRICTION
& RUBBER
TAPES

For SAFETY'S sake . . . use CONDUIT
(Full Weight Rigid Steel)

REAL Protection

PLANT reconversion after Victory will bring opportunity to replace unsafe emergency wiring methods and wartime substitute materials with approved time-tested systems.

You can count on using standard-threaded, full-weight rigid steel electrical conduit wherever real protection is needed -- for strength and endurance, for prevention of penetration of moisture, vapors and dust, for effective resistance to shock, vibration, corrosion, arcing and short circuiting.

After the demands of war are satisfied, you'll be able to get all the rigid steel conduit you want. Your distributor will have Youngstown BUCKEYE CONDUIT in stock again -- in all the sizes and quantities you'll need.

THE YOUNGSTOWN SHEET AND TUBE COMPANY
YOUNGSTOWN 1, OHIO
Manufacturers of
CARBON, ALLOY AND YOLOY STEELS

Right - This upper floor remained unfinished for several years. The rigid steel conduit afforded vital protection to wiring, against careless workmen and intruders.

Ask your distributor for:
Youngstown Buckeye Conduit . . . Pipe and Tubular Products . . . Sheets . . . Plates . . . Tin Plate . . . Bars . . . Rods . . . Wire . . . Nails . . . Tie Plates and Spikes

BULLDOG BUSTRIBUTION DUCT FOR "PLUG-IN" POWER AT ANY POINT

BullDog has been looking ahead for nearly half a century.

That is why industrial users expect from us one outstanding development after another in electrical distribution. That is why *proved* BullDog equipment will figure increasingly in the changeover plans of leading plants all over the country.

BullDog BUStribution Duct is the original "plug-in" system which gives you electrical power WHEREVER and WHENEVER you need it. Designed to stay modern, its pre-fabricated units can be re-assembled anywhere—new branch circuits added—feeder lines extended. It is 100% salvable, too—no fixed wiring to tear out.

It is not a day too soon to plan peacetime adjustments in your plant. Is your factory power system as *flexible* as your future plans may call for?

BUStribution Duct will take care of your wartime requirements as well as future ones. It will pay you to investigate. Write for illustrated bulletins or consult BullDog field engineers.

BUY WAR BONDS

BULLDOG

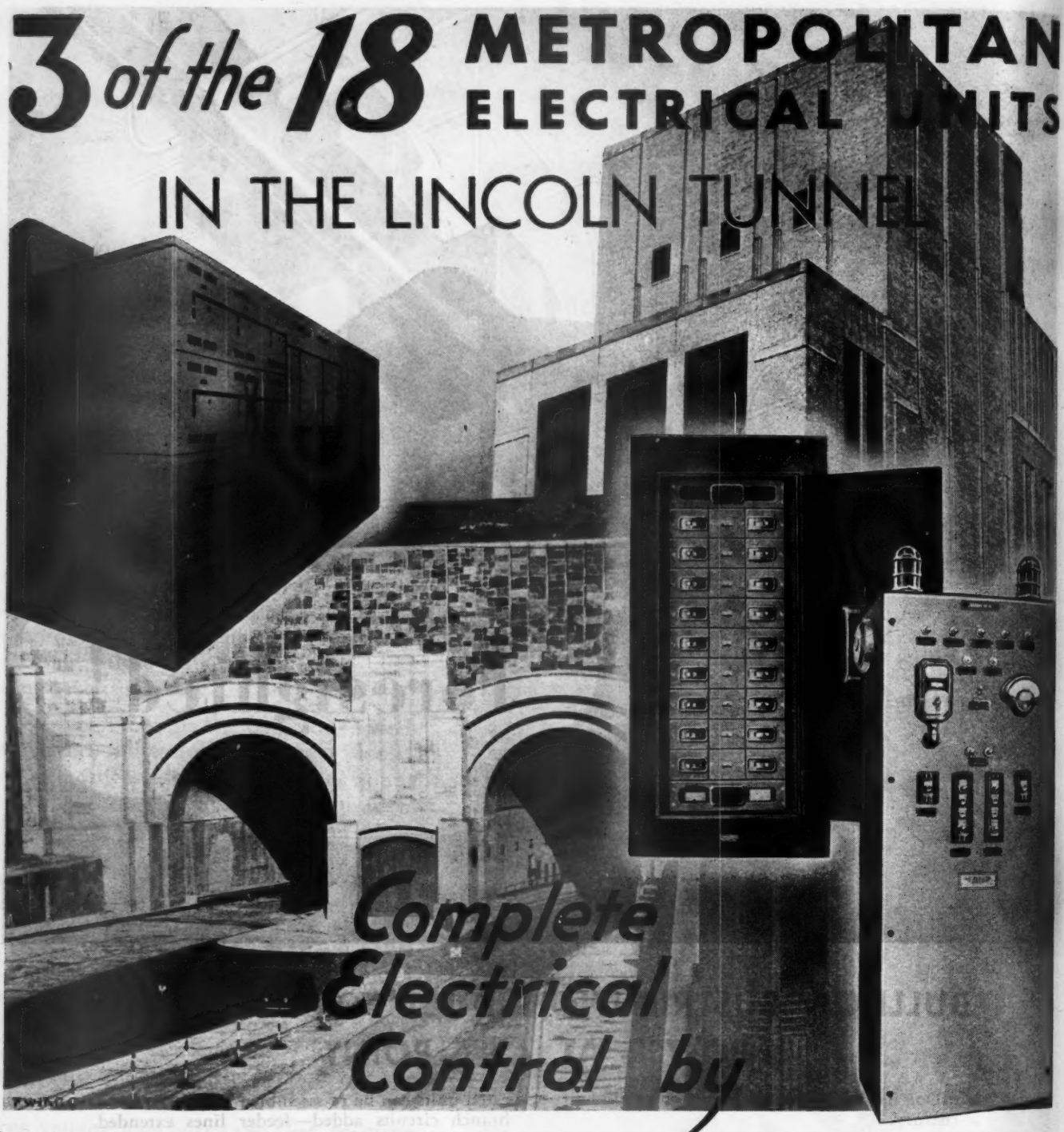
ELECTRIC PRODUCTS COMPANY

SALVAGE PAPER

BOX 177, R. PK. ANNEX, DETROIT 32, MICHIGAN. In Canada: BullDog Electric Products, Ltd., Toronto. Field Engineering Offices in All Principal Cities.

Also Manufacturers of
Vacu-Break Safety Switches—SafToFuse Panelboards—Switchboards—Circuit Master Breakers—BUStribution DUCT, for "plug-in" power—Industrial Trol-E-Duct, for movable "loads."

3 of the 18 METROPOLITAN ELECTRICAL UNITS IN THE LINCOLN TUNNEL

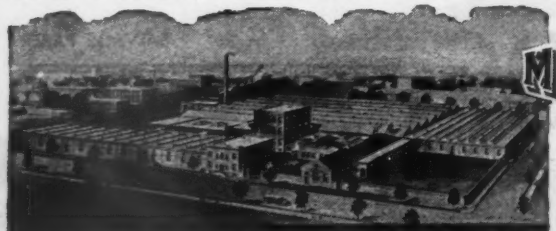


Complete Electrical Control by

At the right are listed various types of electrical control equipment designed and furnished by METROPOLITAN for utilities, industrial plants, large mercantile establishments, and public buildings. Your inquiries are invited.

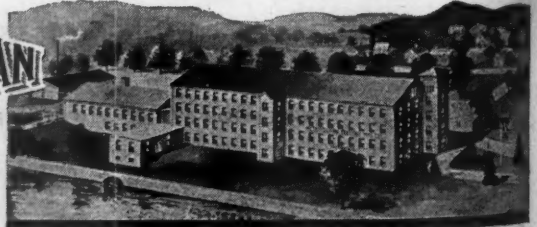
Knife Switchboards
Circuit Breaker Switchboards
Dead Front Switchboards
Battery Charging Switchboards
Motor Control Switchboards
Explosion-proof Switchboards
Laboratory and Test Switchboards
Control Switchboards
Generator and Distribution Switchboards

METROPOLITAN ELECTRIC MANUFACTURING CO.



ESTABLISHED 1892
METROPOLITAN
TRADE MARK

ELECTRIC LIGHTING AND POWER DISTRIBUTION EQUIPMENT



GENERAL OFFICES: LONG ISLAND CITY, N. Y. FACTORIES: LONG ISLAND CITY, N. Y., & WEST WARREN, MASS.

DISTRIBUTED ONLY THROUGH ELECTRICAL WHOLESALERS

there is a Leader commercial unit

for every type installation

Is your problem low cost or simple streamlined beauty . . . fast easy installations or coordinated architectural design? Leader commercial fixtures can solve your problem.

Leader units are specified and installed nationally by leading architects and engineers. Maintenance men find them easy to service, rugged, long lasting and efficient.

Straight line wholesale distributor merchandising methods plus full Leader cooperation assures maximum profits.

Descriptive literature furnished on request or contact a Leader representative.

G-440: GLASS ENCLOSED LOUVER UNIT. This unit is especially designed for offices. Reflective louver design permits full downward light output without side glare. Streamlined and more attractive than similar units of equal light intensity.

GL-440: Four-light, 40-watt, glass enclosed louvered unit. A hinged panel with simple fasteners facilitates relamping and servicing. Designed for pendant suspension or ceiling mounting, or constructed for individual or continuous run installation.

L-440: Four-light, 40-watt, parabolic louver type unit, specifically suited for drafting rooms and production offices where general over-all light is required. Available for pendant or ceiling suspension mounting, continuous run or individual installation.

VL-440: THE LEADER OFFICER. Four-light, 40-watt, plastic louvered, 2-louvered unit, combining the finest in design, construction, and servicing feature, this unit offers the ultimate in lighting equipment. Available for pendant or ceiling suspension mounting, individual or continuous run installation.

LEADER ELECTRIC MANUFACTURING CORP. • 6127 BROADWAY • CHICAGO 40, ILL.

WEST COAST FACTORY

2040

Cooler Cables!

LABORATORY TESTS PROVE:

TRANSITE DUCTS DIFFUSE HEAT FASTER!

FROM LABORATORY TESTS lasting more than two years comes proof of the superior heat-dissipating qualities of Johns-Manville Transite Ducts.

By applying the data from the tests to specific field conditions, J-M Engineers have determined the comparative I^2R losses of underground ductways in actual operation. They have found, as a result of a number of such studies, that Transite Ducts dissipate these losses up to 13% faster than the other ductways tested.

It is apparent, therefore, that cables in Transite Ducts have a higher inherent load capacity. Or, carrying rated loads, cables will run cooler, thereby reducing copper losses and increasing cable insulation life.

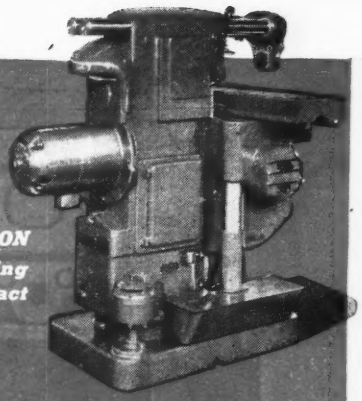
Transite Ducts are strong, immune to rust and rot, incombustible, not affected by electrolysis or galvanic action. Smooth bore makes possible long cable pulls and easy replacements. Long, lightweight lengths can be quickly installed. And, a variety of fittings simplifies even the most complicated installations.

For full information write for Data Book DS-410, Johns-Manville, 22 East 40th Street, New York 16, New York.

Johns-Manville **TRANSITE DUCTS**

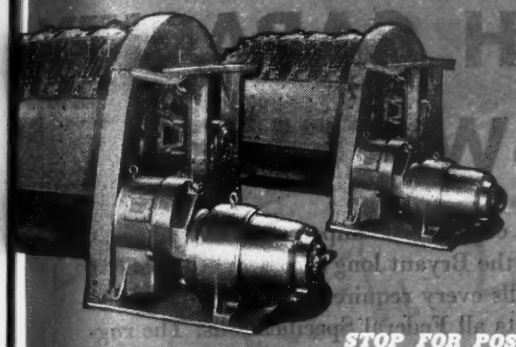
CONDUIT for use without concrete

KORDUCT for concreting in



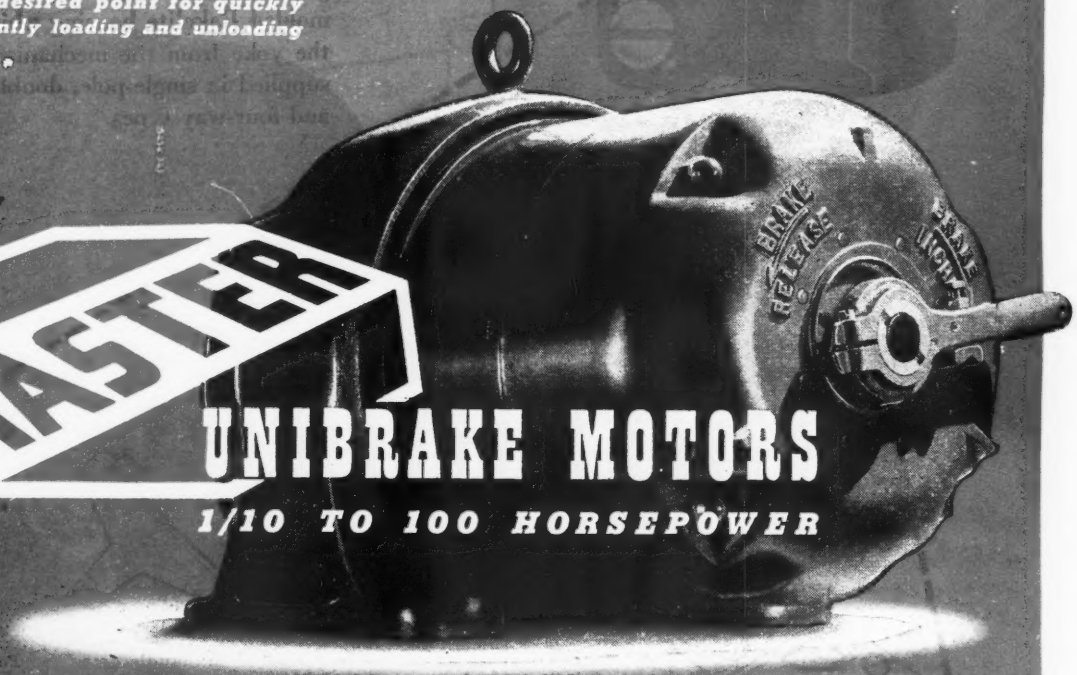
SPEED UP PRODUCTION

Save time by stopping quickly with a compact integral brake unit



STOP FOR POSITION

Stop at the desired point for quickly and conveniently loading and unloading

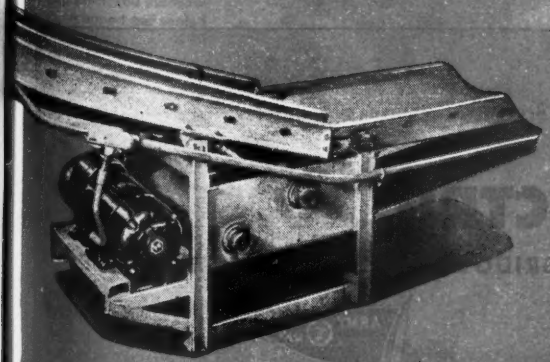


MASTER

UNIBRAKE MOTORS

1/10 TO 100 HORSEPOWER

THE MASTER ELECTRIC COMPANY • DAYTON, OHIO

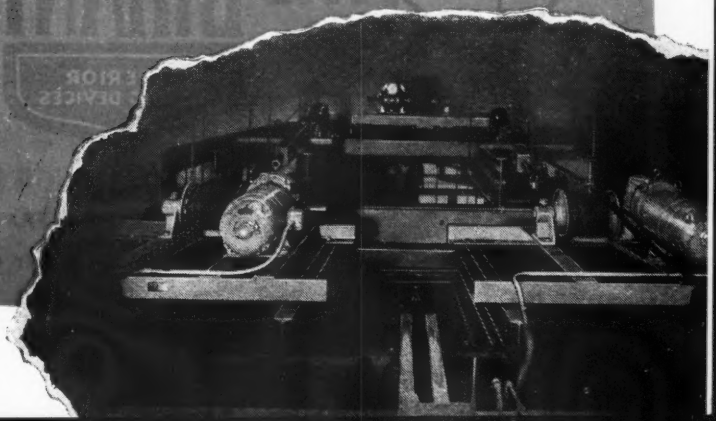


STOP AND HOLD ANY LOAD

Unibrake motors are very advantageous on hoists, elevators, inclined conveyors, etc. . . .

STOP FOR SAFETY

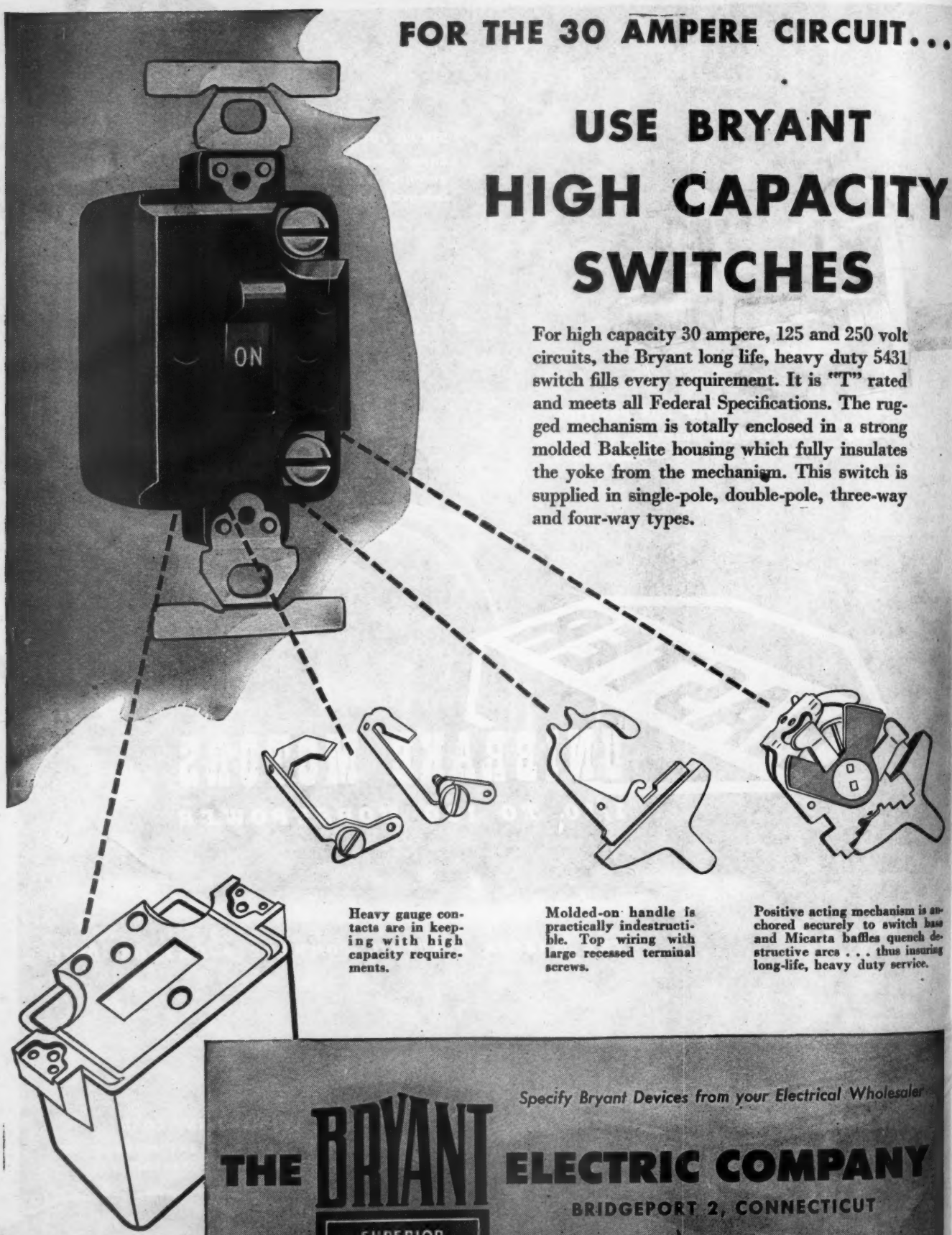
Reduce the hazard of injury to workmen or damage to equipment which might cripple vital production



FOR THE 30 AMPERE CIRCUIT...

USE BRYANT HIGH CAPACITY SWITCHES

For high capacity 30 ampere, 125 and 250 volt circuits, the Bryant long life, heavy duty 5431 switch fills every requirement. It is "T" rated and meets all Federal Specifications. The rugged mechanism is totally enclosed in a strong molded Bakelite housing which fully insulates the yoke from the mechanism. This switch is supplied in single-pole, double-pole, three-way and four-way types.



Heavy gauge contacts are in keeping with high capacity requirements.

Molded-on handle is practically indestructible. Top wiring with large recessed terminal screws.

Positive acting mechanism is anchored securely to switch base and Micarta baffles quench destructive arcs . . . thus insuring long-life, heavy duty service.

The molded Bakelite housing provides a strong frame for the mechanism and keeps out dust and dirt.

Specify Bryant Devices from your Electrical Wholesaler

THE BRYANT ELECTRIC COMPANY

SUPERIOR WIRING DEVICES

BRIDGEPORT 2, CONNECTICUT

ARMY E NAVY

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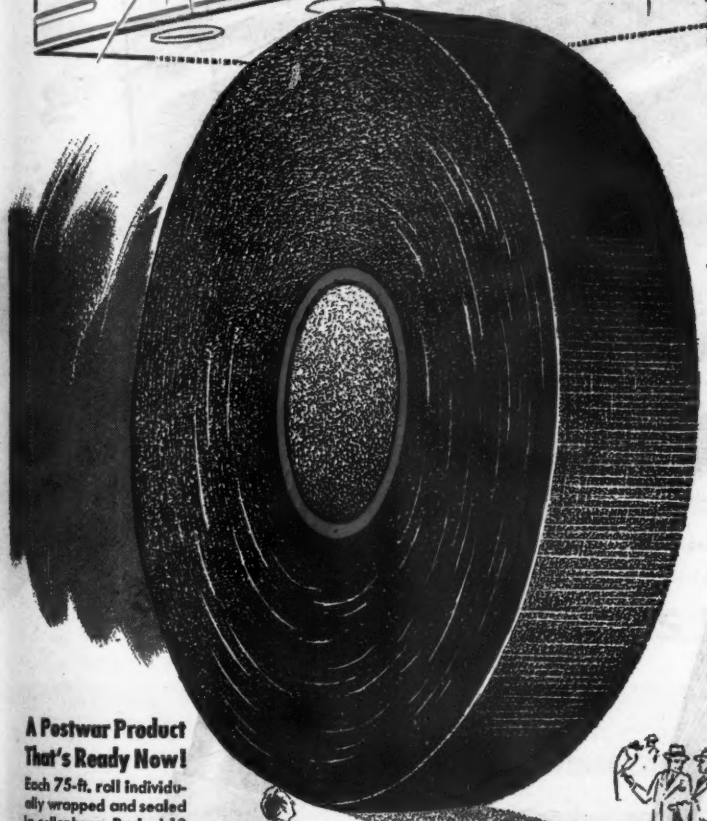
A SUBSIDIARY OF WESTINGHOUSE ELECTRIC CORPORATION

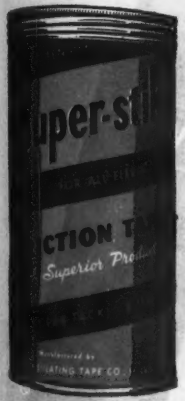
THE NEW MEMBER OF THE S FAMILY

A NEW TAPE IN LEADING ROLE



A Postwar Product That's Ready Now!

Each 75-ft. roll individually wrapped and sealed in cellophane. Packed 10 rolls to the can.



S-750

IN the few months that Super-stik has been available, it has become a "star" in the tape field. . . . It is a new product —a Mintert calender-process tape— laboratory developed with greater adhesive and tacky properties that are easy to see when you unroll it. . . . Sticks to the job because it sticks to itself—is clean—doesn't stick to the hands—high tensile—doesn't ravel, peel, curl or unwind.

Try Super-stik. Available on suitable priorities. Ask your electrical wholesaler for a sample

SUPERIOR INSULATING TAPE CO.

ST. LOUIS, MO., U. S. A.

Established 1923

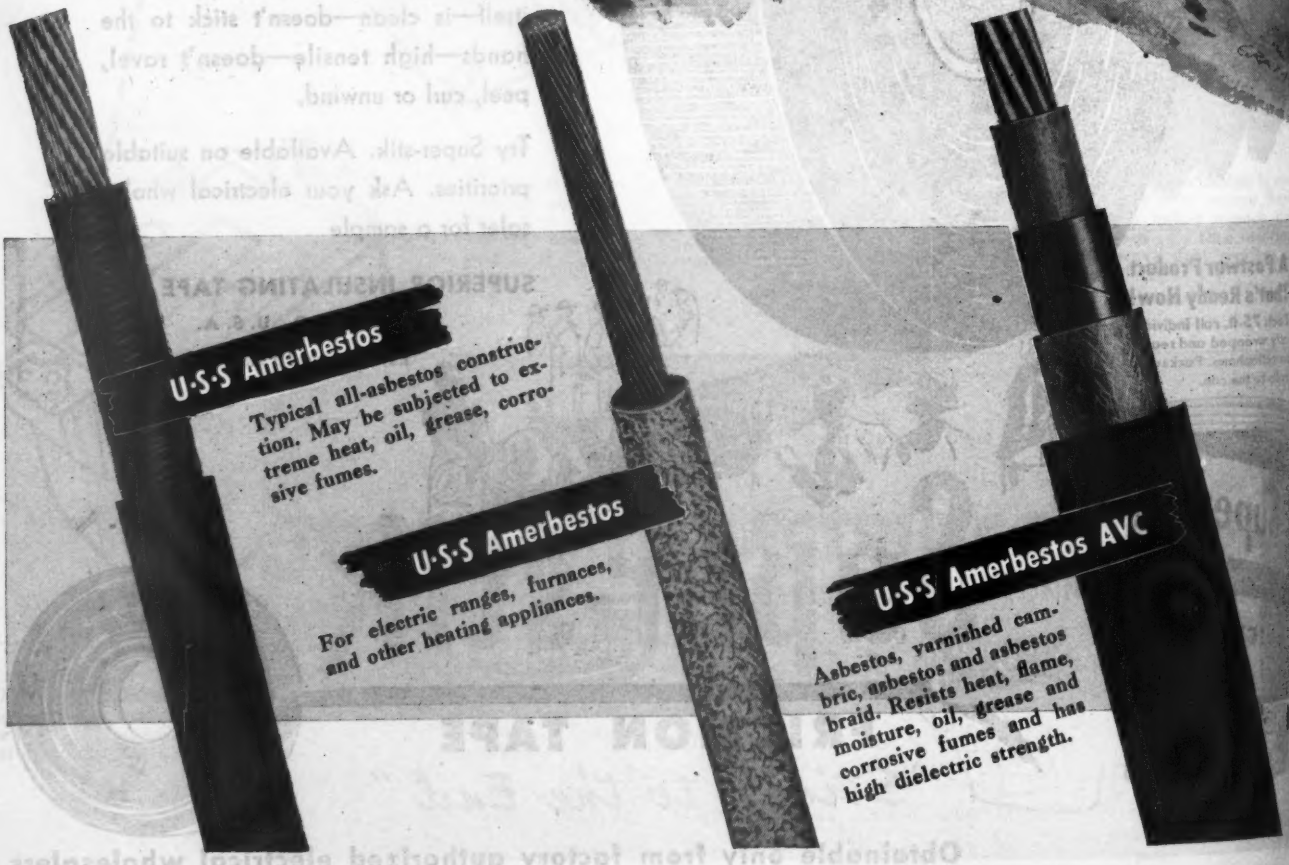
Super-stik

FRICTION TAPE

"Sticks to the End"

Obtainable only from factory authorized electrical wholesalers

How HOT is the inside


U·S·S Amerbestos
Typical all-asbestos construction. May be subjected to extreme heat, oil, grease, corrosive fumes.
U·S·S Amerbestos
For electric ranges, furnaces, and other heating appliances.
U·S·S Amerbestos AVC
Asbestos, varnished cambric, asbestos and asbestos braid. Resists heat, flame, moisture, oil, grease and corrosive fumes and has high dielectric strength.

# of a Fighting Ship?

. . . so hot it takes asbestos insulated cables to survive!

IT is always torrid down around the engines and boilers of fighting ships . . . so hot that the ordinary insulation for electric cables disintegrates. Moisture could cause short circuits and the insulation would offer little resistance to flame.

As our contribution to the solution to some of these problems, engineers at American Steel and Wire Company adapted the famous U·S·S Amerbestos Wire and Cable which had already proved so successful for electric heating appliances, ranges, locomotives and hot locations in power plants and mills.

Amerbestos Cable can be made with high resistance to heat, flame, moisture, oil, grease and corrosive fumes. Today, thousands of miles of Amerbestos are used for power and control in our fighting ships.

Amerbestos Cable is essentially a copper conductor with a layer of tough asbestos felt covered with asbestos braid. When more dielectric strength is needed, a layer of varnished cambric and a second layer of asbestos felt are added. Where resistance to moisture, oil, grease and fumes is necessary, the cable is impregnated with MFH (moisture, flame and heat) black saturating compound.

If you need electric wire or cable of any kind, for hot spots, wet locations, or rough use, get in touch with us. Most of our output is made for special uses. We can undoubtedly meet your most difficult requirements.

American Steel & Wire Company

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Export Company, New York

UNITED STATES STEEL

Other U·S·S American Electric Wire & Cable Products

New PS Conducting Rubber Shielded Wire and Cable.

Ampyrol—Synthetic-insulated wire and cable for switchboards and machine tools.

Amerclad—Tough abrasion resisting cable for portable tools, motor leads, power cable.

U·S·S American Amerbestos Wire & Cable

NOW Get the Right Varnish for that Insulating Job

Quickly-Easily-Accurately...

WITH THIS HANDY VARNISH SELECTOR

IT'S FREE!

Ask your G-E Distributor for it

A quick glance at this handy, easy-to-use Varnish Selector gives you all the facts on 7 outstanding insulating varnishes — characteristics, applications, baking and drying time, base, thinner, viscosity—everything you want to know. Ask your local G-E Merchandise Distributor for one and you'll always have this essential information at your finger tips, ready to use. A list of G-E Distributors is available on request from Section RIMA-652-33 Resin and Insulation Materials Division, General Electric Company, Schenectady 5, New York.

SEND THIS COUPON NOW TO YOUR LOCAL G-E MERCHANDISE DISTRIBUTOR

Gentlemen:

Please send me a G-E Insulating Varnish Selector as offered in Electrical Contracting.

Name.....

Title.....

Company.....

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GENERAL ELECTRIC

from sand . . .

SILASTIC

the new DOW CORNING SILICONE RUBBER

SILASTIC QUALIFIES EQUIPMENT UNDER GRADE 1, CLASS 1 SPECS.

Resistors coated with SILASTIC SC-75 operate successfully at 275°C. and take the plunge from 275°C. into ice water nine successive times. This seemingly impossible shock performance permits resistors coated with SILASTIC SC-75 to qualify under Grade 1, Class 1 Specifications.

"Newsworthy" is the development by Dow Corning of yet another—and perhaps greater—contribution to the new-day efficiency and resourcefulness of American industry. SILASTIC* is the name of the product and silicone rubber is the achievement.

SILASTIC covers a variety of elastic silicone products made by Dow Corning from sand, modified by chemicals drawn from brine, coal and oil.

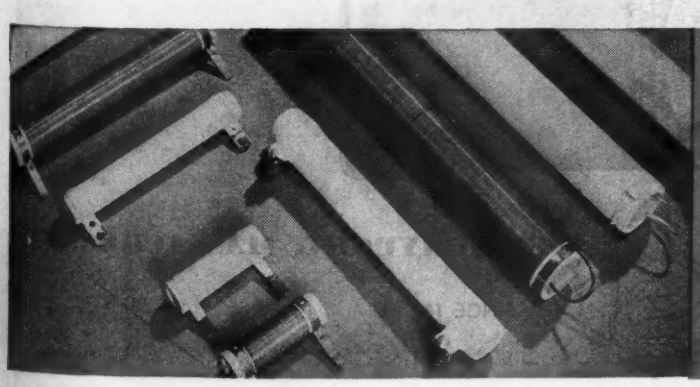
Being silicone rubber, SILASTIC exceeds in thermal stability the rubber we've known, whether natural or synthetic. SILASTIC retains complete flexibility—does not harden—in the temperature range—70°F. to 500°F. Its excellent dielectric properties—its arc, corona and oxidation resistance—assure durability of wire insulation under hot, wet service conditions.

For the immediate broad field of its usefulness, SILASTIC stocks are available for application by coating, extruding and molding.

DOW CORNING CORPORATION • MIDLAND, MICHIGAN

ADDRESS ALL INQUIRIES TO BOX 592

*TRADE-MARK DOW CORNING CORPORATION



Dow Corning

FIRST IN SILICONES

TO KEEP GOING

free from needless circuit interruptions and production shutdowns, use Shawmut Shur-Lag Renewable Fuses. They are the simplest and sturdiest renewable fuses made, and the quickest and easiest to renew. Having the least number of parts of any renewable fuse, they are solidly built; they remain in perfect alignment and contact, unaffected by vibration or repeated heating. Shur-lag links are equally unsurpassed in simplicity and effectiveness. You can choose one that will give the longest time-lag of any renewable fuse at the needed critical points. For over 50 years Shawmut fuses have ended fuse troubles. They will end yours now. Use Shur-Lag and be sure.

THE CHASE-SHAWMUT COMPANY **NEWBURYPORT, MASSACHUSETTS**

FUSE MAKERS SINCE 1893

"NOT IN THIS BUILDING," said the Chief. "You can see where the flames burned around them, but the wires, though badly damaged, didn't spread the fire. It sure resists flame, that new insulation!"

Yes, VINYLITE plastic insulation for wires and cables is *rugged*.. And the non-flammable types bring new security from damage by fire —an important factor to utility companies, industrial plants, shipbuilders, and construction firms. In addition, the excellent dielectric properties of VINYLITE plastic insulation permit thin-wall construction, with resulting reduction in weight and thickness. Thus it is possible to put more circuits in existing conduits. It is also highly resistant to most chemicals and to alkalies, oils, grease, sunlight, and abrasion; remains flexible at low temperatures; and has an unusually low rate of water absorption.

Whatever your requirements in the broad range from portable cords to power cables, adopt VINYLITE plastic insulation for new standards of safety and service life. Write Department 41 for booklet, "VINYLITE Plastics for Wire and Cable Insulation."

BAKELITE CORPORATION

Unit of Union Carbide and Carbon Corporation

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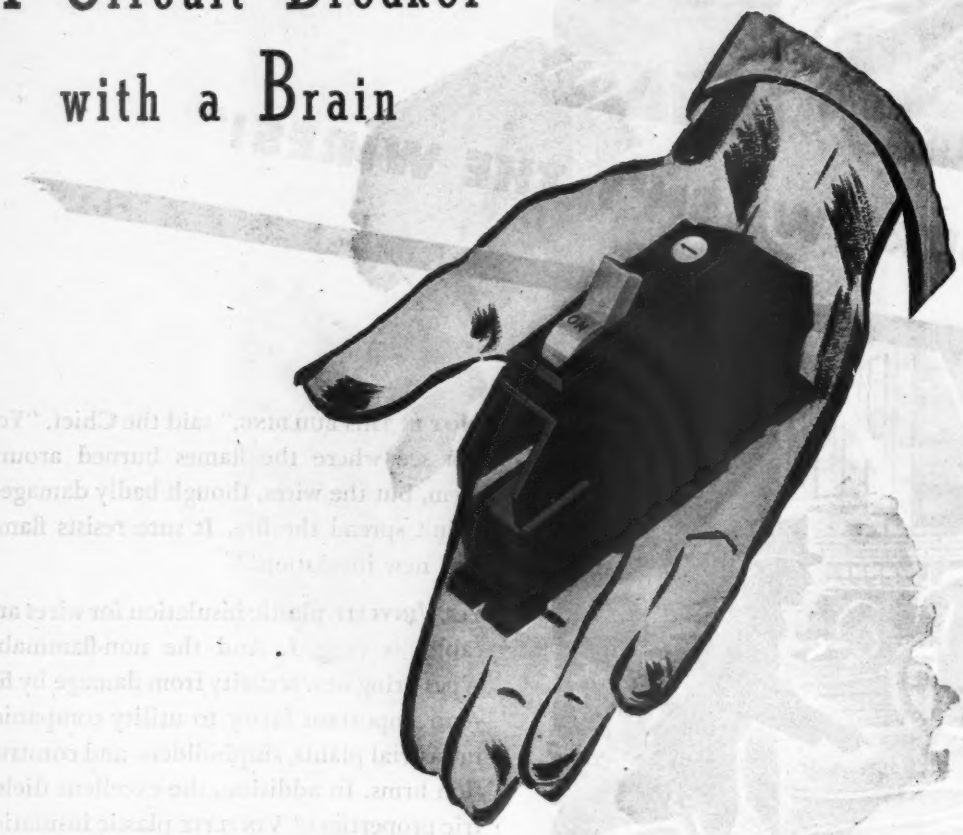
30 EAST 42ND STREET, NEW YORK 17, N.Y.

Vinylite Plastics

TRADE-MARK

A Circuit Breaker with a Brain



Ⓕ TYPE AC THERMAG* CIRCUIT BREAKER

It breaks electric circuits with a THERmal, MAGnetic brain. That's how it got its name. People who believe in taking *care* of their electrical equipment like the discrimination the Ⓕ Type AC THERMAG circuit breaker uses in deciding *when* circuits should be broken.

The THERmal trip interrupts only sustained overloads — making allowances for starting load and normal momentary overloads. The MAGnetic break, however, has a single track mind . . . *break that circuit fast* on any short circuit before damage can occur.

Small and compact, there is nothing to replace . . . service is restored with a flip of the finger. Capacities of 15, 20, 25, 35 and 50 amperes at 120 volts, AC only, provide a wide range of protection for appliances and lighting.

THERMAG circuit breakers come in Ⓕ Panelboards for factories and large buildings . . . Ⓕ Load Centers or Service Equipment for homes . . . in dust-tight cabinets for Class II, Groups F and G, hazardous locations. Write for BULLETINS 63 and 67 for full details.

Frank Adam Electric Co., Box 357, St. Louis, Mo.

EST. 1891 — THE SIGN OF A BETTER JOB
Frank Adam
ELECTRICAL PRODUCTS
FRANK ADAM ELECTRIC CO. ST. LOUIS, MO. U.S.A.

*Trade Mark Reg. U. S. Pat. Off.

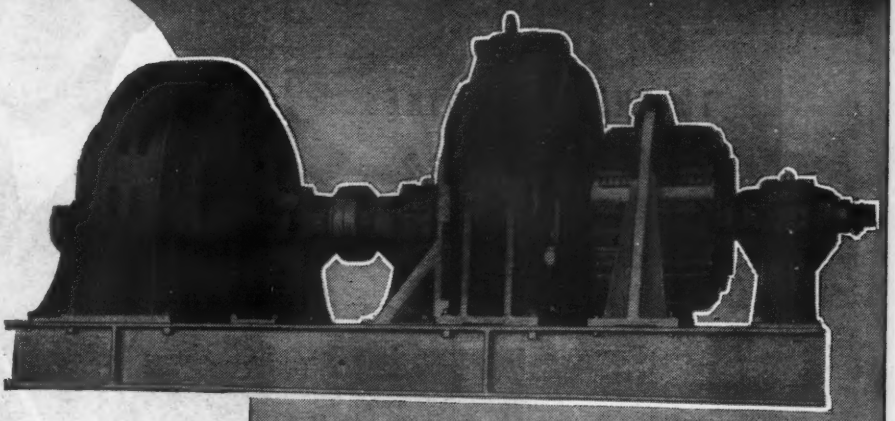
BURKE 1 to 1000 K.W. MOTOR GENERATOR SETS

BURKE for 54 years a builder of motors and generators in a wide range of types and sizes has the specialized experience to combine these units in M-G Sets to meet any current demand to 1000 K.W.

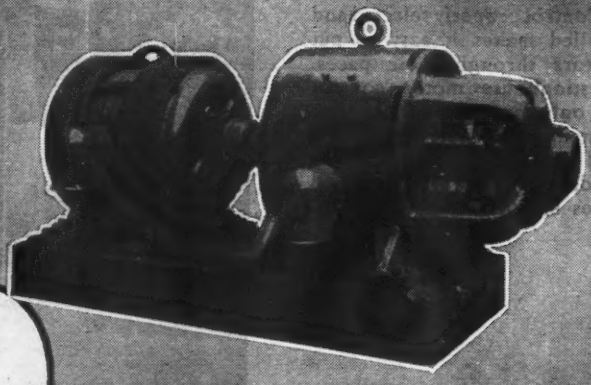
In addition to a standard line of M-G Sets both Synchronous and Induction motor driven, Burke also builds special combinations of A.C. to A.C.; D.C. to A.C.; or D.C. to D.C. Motor Generator Sets.

As each motor, generator application varies to meet individual sets of conditions it is good business to consult a specialist. Send your M-G problem to Burke.

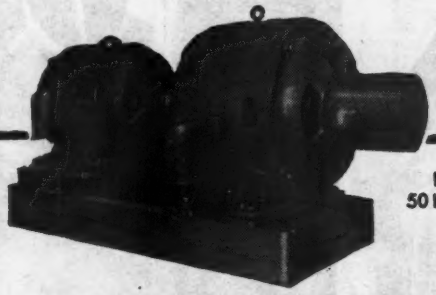
BURKE ELECTRIC COMPANY
1356 West 12 St.
ERIE, PENNSYLVANIA



Burke 1000 K.W. Motor Generator Set. 720 R.P.M. Synchronous Motor Driven.



Burke 75 K.W. Motor Generator Set. 1200 R.P.M. Induction Motor Driven.

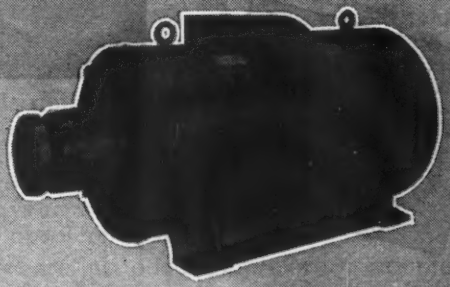


Burke 180 Cycle 50 K.V.A.; A.C. to A.C. M-G Set

BURKE PIONEERED THE HIGH CYCLE M-G SET

to furnish high frequency power with exceptionally good voltage characteristics for driving high speed tools. These sets are standardized in 6.25; 12.5; 25; 40; 50; 62.5; 75 and 93.8 K.V.A. Larger sizes built to special order.

Write for booklet No. 400.



Burke 15 K.W. Motor Generator Set. 1800 R.P.M. D.C. Motor Driven.

MOTORS 1 TO 1500 H.P. • GENERATORS 1 TO 1000 K.W

BURKE A.C. & D.C. Motors & Generators

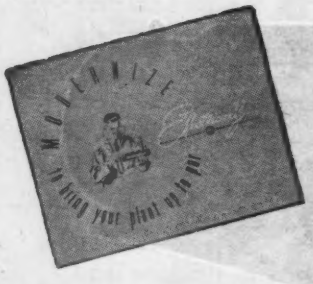
BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • Since 1901

"JOB-FITTED" DRIVES

TO BRING MACHINES

Up to par

Control properly selected and applied makes it easy to put motors through their paces. Westinghouse motor control not only covers the entire range of standard a-c and d-c controls and accessories for every type of drive, but many specialized types of control.



. . . ONE OF 22 WAYS YOUR

WESTINGHOUSE DISTRIBUTOR

CAN HELP YOU MODERNIZE

Electrically

TWENTY-ONE OTHER WAYS your Westinghouse Distributor can help you in planning electrical modernization, whether for a single department or your entire plant, are suggested in this new book. It provides a valuable check list on modern electrical practices . . . from incoming electrical power to methods of utilization and control. Ask your Westinghouse Distributor today for a copy of B-3476, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

For efficient, trouble-free speed reduction within the standard range of 1 to 75 hp—use a Westinghouse Gearmotor. You buy your power *pre-packaged* at the speed you want —ready for simple, instant assembly.

Bought now, Westinghouse Type CSP prelubricated motors need no greasing till 1950! Extensively field tested, prelubricated ball bearings in Westinghouse CSP general-purpose motors have proved they can operate five years . . . 24 hours a day . . . without greasing. This feature is standard on CSP motors up to 3 hp.

Motors, like people, can be square pegs in round holes. You may have improvised but you will need motors that are "job-fitted" to compete with the newly-built, highly efficient war plants.

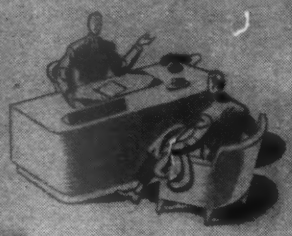
Your Westinghouse Distributor is equipped to help you. He will make a thorough survey of your motor drives, plus a full electrical checkup of your work, to make sure you are using the most efficient motor drive. He'll also tell you what's new about a lot of things electrical . . . and suggest ways in which you can "revitalize" or replace equipment which is now obsolete or inefficient.

"Job-fitted" motor drives are just one example of the completeness of the service he has to offer. Westinghouse also offers *all* types of motors, control and gearmotors to "revitalize" your plant from A to Z. These are only a few of the hundreds of items he can supply to help you "modernize electrically".

Why gamble on electrical equipment and motor drives that you know are doubtful? Check up now . . . revitalize . . . replace . . . with the help of your Westinghouse Distributor. J-90562

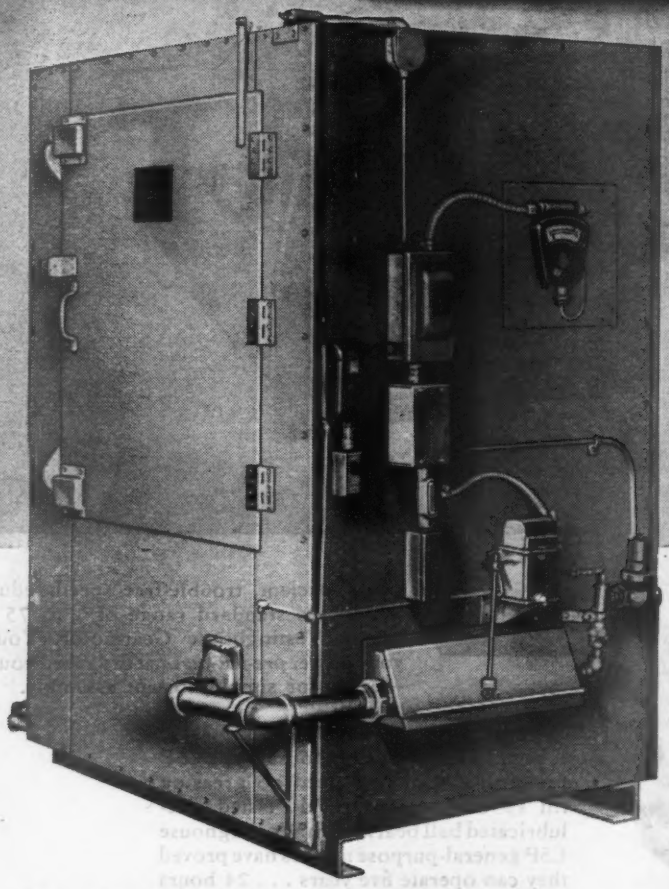
Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE



INFORMATION

FOR YOU IF YOU REWIND *Electric* MOTORS . . .



Single compartment Young Brothers burn-off oven.

Removing the old insulation from the stator windings has always been a tedious and often a costly operation. By using this new Young Brothers Burn-off Oven, that is all changed. Specifically this recently developed oven assures you the following advantages:

1. Temperature and timing under accurate control.
2. A thoroughly incinerated stator in less time than by any other method.
3. The stator frame will not warp or crack.
4. Stripping time is reduced to minutes.
5. Reduction of labor time in preparing the stator for the burn-off.
6. Complete elimination of smoke and fumes from the shop.

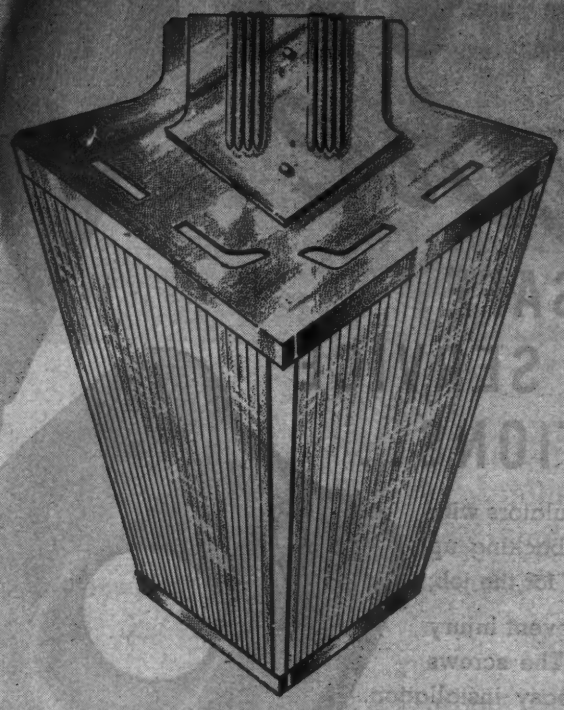
This oven, engineered by the same organization which for years has built armature and coil baking ovens, has been thoroughly tested and proven in some of the largest motor maintenance shops in the country. We will give you their names if you want to investigate.

YOUNG BROTHERS COMPANY

6526 MACK AVENUE **DETROIT 7, MICHIGAN**

YBCo

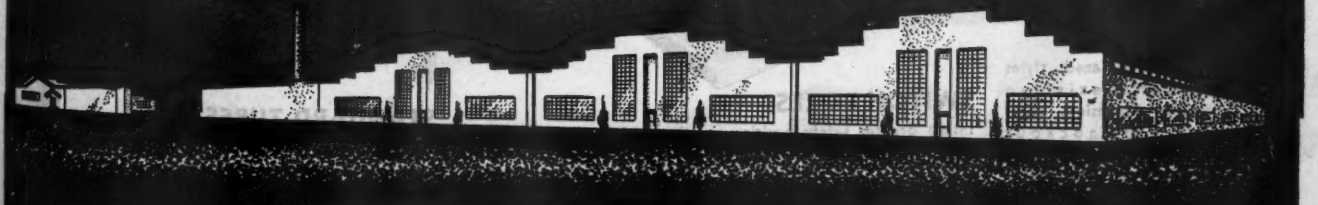
ESTABLISHED IN 1896



Lite-A-Nite Semi-Indirect Fluorescents

Smartly styled for appearance and engineered for high lighting efficiency, ease of installation and servicing, Light-A-Nite Fixtures more than meet the most rigid requirements of performance, beauty and maintenance. Some outstanding Lite-A-Nite features are rich-soft diffusing glass that eliminates glare and properly directs light rays, attractive two-toned ends that permit continuous mounting, lamp replacements without removing ends and furnished for either individual, surface, pendant or line mounting.

Lite-A-Nite is available in 2-3 or 4, 40 Watt units with either conventional or instant start ballasts. Write today for complete information.



LIGHTING PRODUCTS INC.

HIGHLAND PARK — ILLINOIS

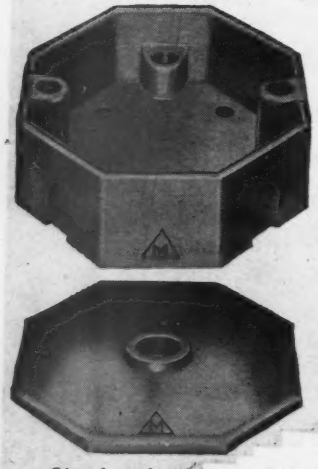
ILLINOIS
PORCELAIN WIREHOLDER
INSULATORS

Insure
SAFE HOUSE SERVICE CONNECTIONS..

• When you use Wireholder Insulators with the name "ILLINOIS" you are backing up your work with the right quality for the job.

All corners are rounded to prevent injury to the insulation of the wires. The screws have deep, sharp threads for easy installation. The screws are fastened into the insulators with non-shrinking metal alloy. The all-steel screws are hot galvanized by a special process to insure a smooth, even coating. Will not cause rust streaks on the sides of buildings. These dry process wireholders are made in sufficient styles and sizes to meet all requirements. Wet process porcelain supplied on special order.

OUTLET BOXES



Glazed and unglazed styles conforming to all existing standards of dimensions, spacing, position of knockout holes, and mounting screws. High mechanical and electrical efficiency.

ALL-PORCELAIN ILLINOIS SYSTEMS *for outstanding, adequate and modern wiring jobs*

SWITCH BOXES

Insure greater safety in wiring and the elimination of all grounding hazards. Made of the best quality of white porcelain. Metal inserts are placed in two holes of the switch boxes for receiving screws of standard switches, plug outlets, etc. Knockouts for single wires, also for cables. Specify and use them.

Bull Dog

KNOBS

Cement coated — extra length nail—genuine leather washer — code standard. They don't chip when driven in and they do stay in place and have a firm grip. Available in a wide variety of heights, diameters, holes, and grooves.

STANDARD TUBES

In sizes ½ to 48 inches long, 5/16 to 3 inches diameter in following types: unglazed, glazed, split, floor, split floor, headless, curved and, crossover split, and crossover. Diameters all uniform both inside and outside.

ILLINOIS ELECTRIC PORCELAIN COMPANY *Macomb, Illinois*

NEED *Underground* CABLES TOO!

Much is written these days about the need for underground cables to provide freedom from service failure in the city. Farmers not only have need for underground entrance cable but they also need underground distribution cable from the meter to the various outbuildings.

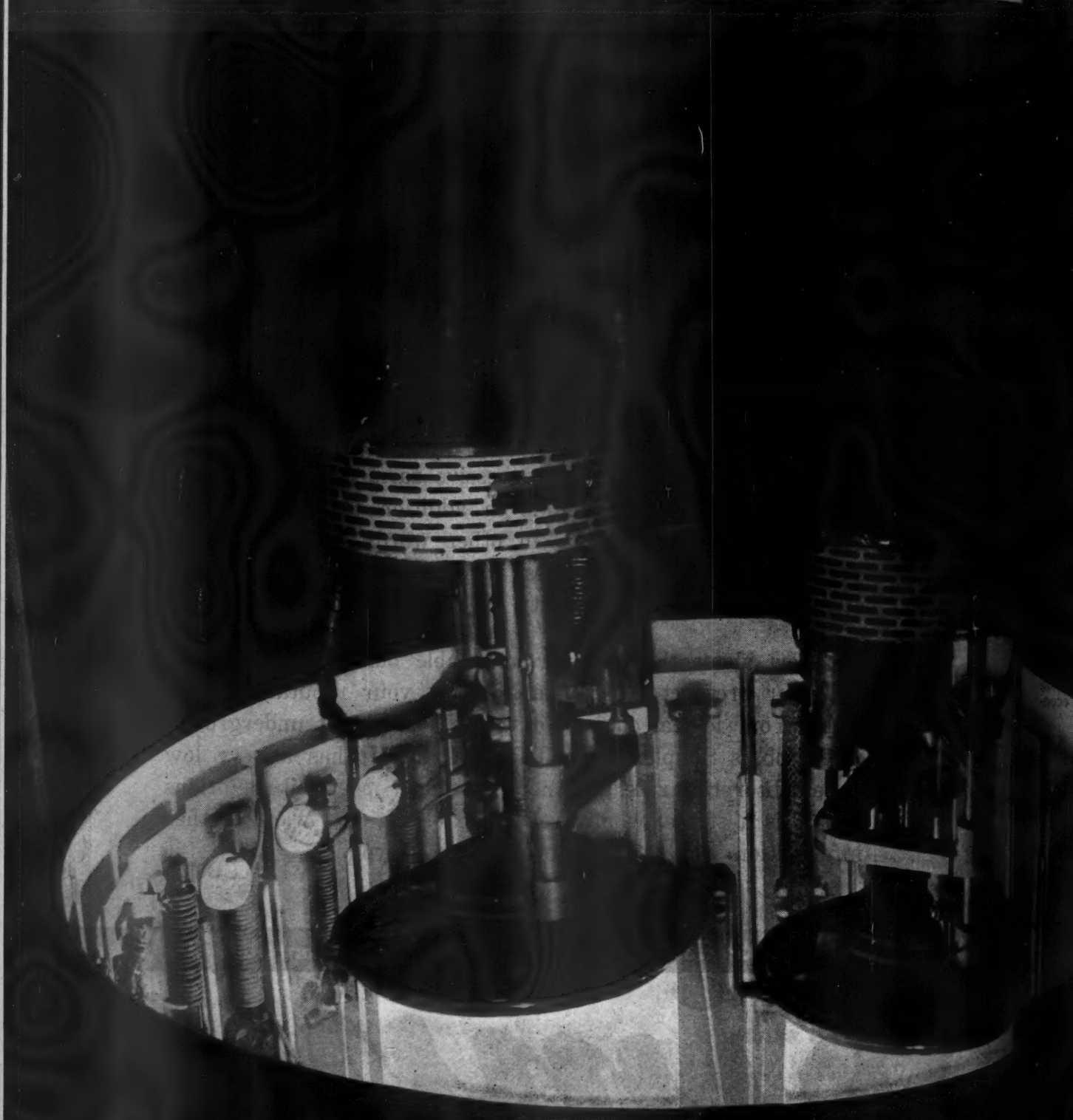
They are going to need a lot of other things too, besides underground cable. They are going to need a lot of wiring in barns, in hen houses, and progressive farmers will need soil heating cable too. All this is in addition to the household appliances city folks want. In other words, the market for electrical contractors' services in the country is even more attractive than it is in the city.

Now about this underground cable business. Unless you sell your prospect a dependable cable, your reputation is at stake. Your logical choice for this all important underground cable job is Simplex-ANHYDREX Cable. It has a very low water absorption rate. It is not affected by most soil conditions and it is a stable, wholly reliable cable. If you want further information we'll be glad to supply it to you.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

Simplex WIRES and CABLES

LONGEVITY



Here, the moisture-permeability of a synthetic is tested in the "Weatherometer", a device which accurately measures the relative time-resistance of various insulating materials to the most damaging elements of weather:—ultra-violet rays, wind, moisture.

OF PRODUCT

Accelerated laboratory "punishment," plus decades of test-yard exposure, cross-check each creative advance through General Cable Research.

Can the inevitable slow deterioration of electrical wires and cables through age and exposure be made 50% slower? Active seeking for such an attainment continues throughout the years of General Cable Research. Now, with ultra-modern sub-zero and tropical temperature cabinets at command — with salt air, acid earth and all other destructive conditions accurately reproduced in the laboratory and its auxiliary test-yard, the search for ultimate longevity strides constantly ahead. From the discoveries of methods such as this are better specifications written, better products born, and the Company's legend "A Standard of Quality for over Half a Century" steadily translated into fact.

GENERAL CABLE CORPORATION

Manufacturers of Bare and Insulated Wires and Cables for Every Electrical Purpose

Know your WIREMOLD

BUSINESS BUILDER IN TOMORROW'S MARKET FOR ADEQUATE WIRING

WIREMOLD RACEWAYS

Ten basic surface metal raceway wiring systems . . . each complete with its own series of fittings . . . inter-connectable one with another . . . providing the ideal method of wiring new structures and rewiring buildings.

WHERE TO USE THEM

In factories, hospitals, offices, warehouses, public buildings, stores, hotels, schools, farm buildings and airport structures . . . where wiring for light, power or communications is installed ON THE SURFACE for convenience and safety . . . where RE-WIRING is a major problem . . . and where frequent changes in occupancy require constant wiring changes. No other wiring methods compare in speed, efficiency, safety and economy for these purposes.

HOW TO USE THEM

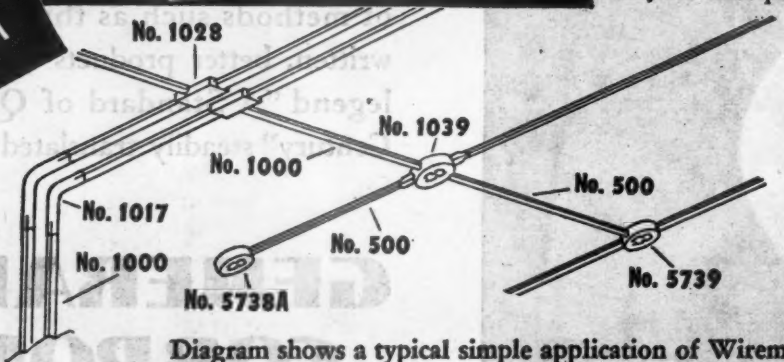


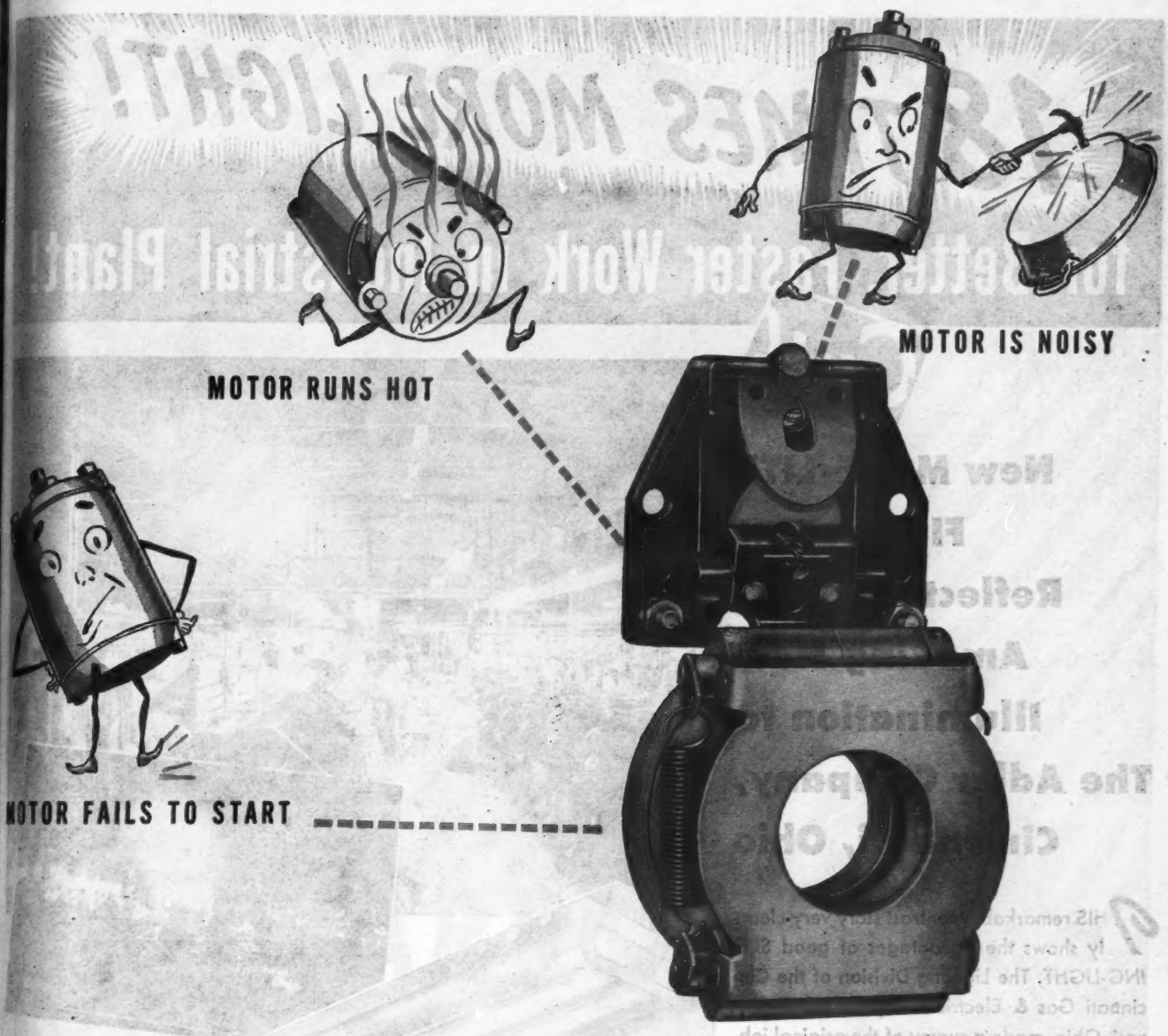
Diagram shows a typical simple application of Wiremold Raceways required in almost every case where lighting modernization dictates relocation and increase in the number of outlets. Quickly installed, unobtrusive Wiremold Raceways eliminate all necessity of channeling plaster walls or ceilings or ripping out old wiring. Know your Wiremold and you know the answers to all problems of this kind. Write us direct for Catalog and Wiring Guide No. 16A.

ELECTRICAL CONTRACTORS

Business publications like these, with aggregate circulation of over 240,000 monthly among your prospects and customers, carry Wiremold advertising messages designed to HELP YOU BUILD BUSINESS. Tie in with this aggressive promotion program.

NEMA

THE WIREMOLD COMPANY
HARTFORD 10, CONNECTICUT



These things shouldn't happen to *your* motors

(and here's one reason why they won't!)

FREE NEW BOOKLETS!

"SHADED POLE MOTORS," Form No. 1887. "MATCHED MOTOR PARTS," Form No. 1871. "UNI-SHELL INTEGRAL H.P. MOTORS," Form No. 1845. "MOTOR GENERATOR SETS," Form No. 1881.

Send for any or all of these booklets, now.

When a motor balks at starting, runs hot, or is excessively noisy, a check-up often reveals that these motor difficulties have the same source—a defective starting switch. Open contacts, switch grounding or failing to transfer from starting to running connection, a switch that rattles or rubs inside the motor—all can produce these symptoms of motor trouble.

To help you avoid this sort of thing with any Uni-Shell Motor, R & M engineers put every newly designed switch on life test. Each new switch is started and stopped every few minutes, literally, hundreds of thousands of times until failure occurs. (Some switches have been known to reach a million!)

Out of this test, one of many that all new motor designs must pass, R & M engineers learn how to give you ever better motors. These motor development experts are always ready to talk over the motor user's problems. Frequently, they save the other fellow plenty of time, money, and effort. They can on *your* problems, too.

ROBBINS & MYERS • INC. MOTOR DIVISION • SPRINGFIELD, OHIO
In Canada: Robbins & Myers Co. of Canada, Ltd., Brantford, Ont.

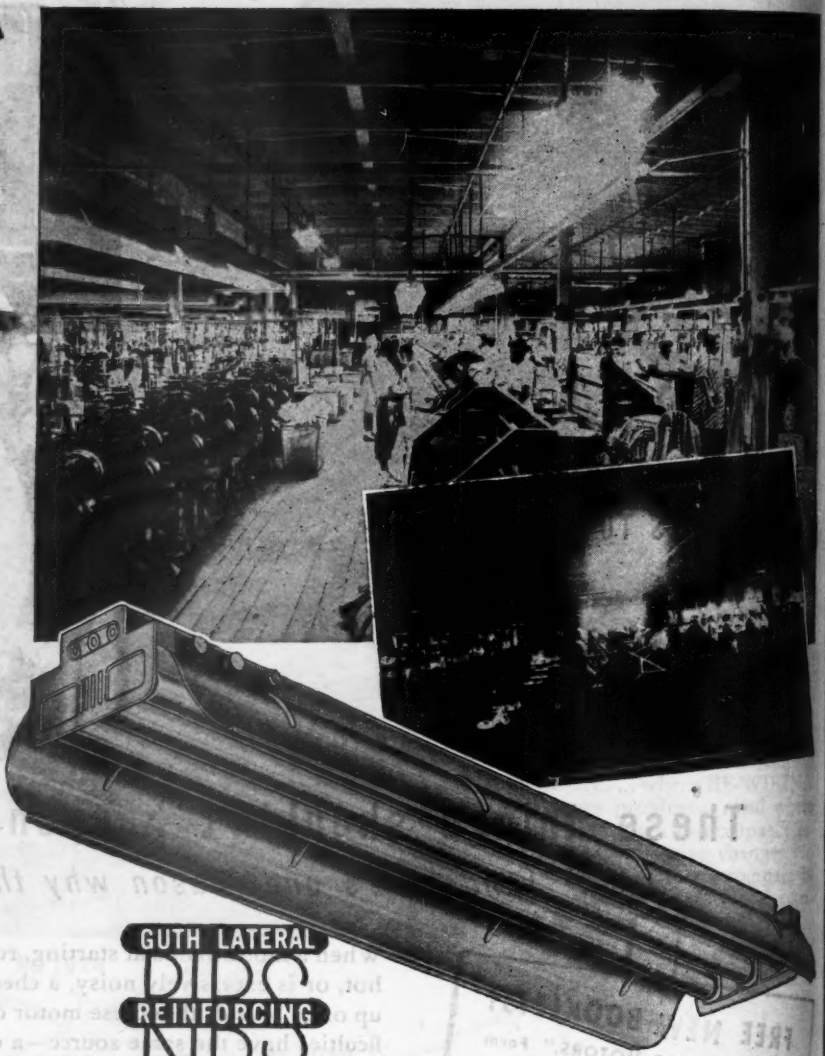
MOTORS • HOISTS • CRANES • MACHINE DRIVES • FANS • MOYNO PUMPS • FOUNDED 1878

18 TIMES MORE LIGHT!

for Better, Faster Work in Industrial Plant!

Guth

New MAZE-LITE Fluorescent Reflectors Bring Amazing New Illumination to The Adler Company, Cincinnati, Ohio



THIS remarkable contrast story very clearly shows the advantages of good *SEEING-LIGHT*. The Lighting Division of the Cincinnati Gas & Electric Company of Cincinnati, Ohio, made a survey of the original job, then recommended an entire new lighting system, using GUTH MAZE-LITES in a definite layout pattern. Installation was sold by the F. D. Lawrence Electric Company, also of Cincinnati.

GLARE, GLOOM AND DEPRESSION keynote the "BEFORE" Photo. Note how bright the incandescent lamps flash against the dark background. Worker's morale is depressed by contrasts. Accidents are more likely because of blinding of eyes due to "bright spots and dark corner" contrasts.

BETTER, FASTER work is accomplished in the re-lighted area. Eyes see quickly, more surely, and there is less nervous fatigue. The "AFTER" photo clearly demonstrates these advantages of good SEEING-LIGHT.

GUTH LATERAL RIBS REINFORCING NIBS
PATENTS PENDING

for Straighter, Stronger Installations

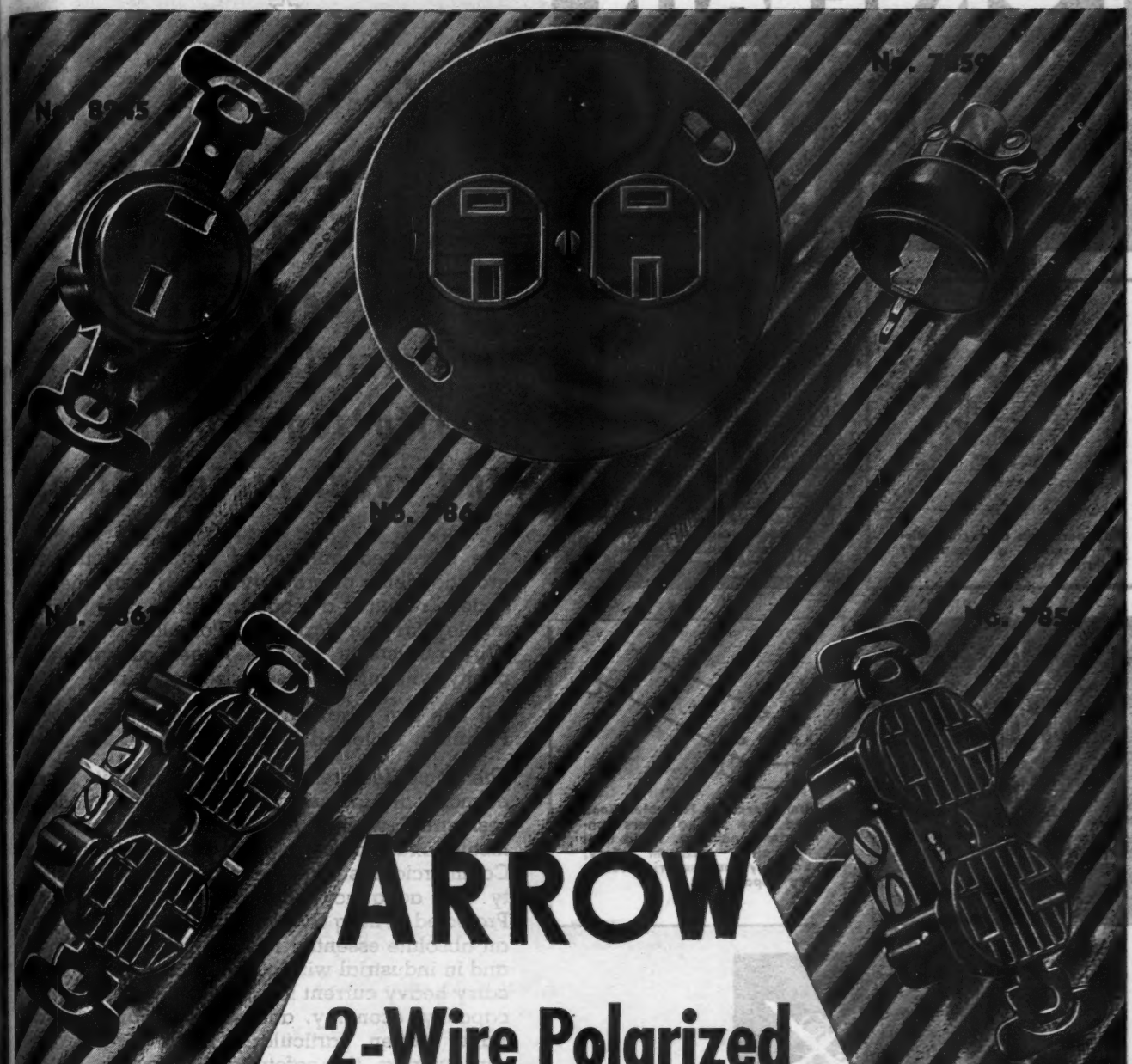
Note the lateral ribs on the MAZE-LITE Reflector pictured above. These ribs in the reflector actually strengthen it; make for a more durable, rigid, and substantial installation—either for individual or end-to-end mounting. MAZE-LITE Reflectors are available with either Porcelain Enamel or "300° White" reflecting surfaces. MAZE-LITES are equipped with "Bump-Proof End-Plates" to protect lampholders; "Side-of-Channel" Starters facilitate Starter replacing. Aircraft-latch makes reflector cleaning simple. MAZE-LITES available with either Conventional or QUICK-LITER accessories.

INSTALLATION DATA

The original wattage was increased but 4.7 times, to obtain *18 times* the "Before" illumination. The "Before" job used 3 KW, with 150-watt lamps at various "spots" throughout the plant, and provided an average of only 5 foot-candles. By engineered and scientific arrangement, the new GUTH MAZE-LITE installation provides 90 foot-candles as installed, and will furnish 70 foot-candles in service.

THE EDWIN F. GUTH COMPANY • 2615 WASHINGTON AVE. • ST. LOUIS 3, MO.

Guth



ARROW

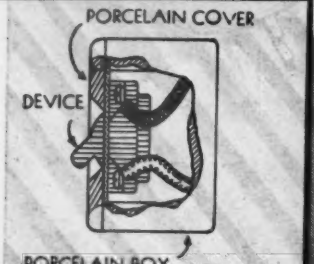
2-Wire Polarized RECEPTACLES

20-Ampere, 250-Volt Outlets for heavy-duty portable electric tools, appliances and heating units. Durable, dependable devices for installations in commercial and industrial establishments, hotels and apartment houses, public buildings and institutions. All-Bakelite bodies, 1" deep; fit standard shallow wall boxes; side-wired for easy access. Nos. 8245, 7860 and 7858 are single-circuit; No. 7861 a 2-circuit type which divides the load, — each outlet independent of the other, with separate feed wires divided at the binding screws with a Bakelite barrier. Available both for flush and surface wiring. Cord-grip Caps have polarized blades rigidly fastened to Bakelite and will not loosen... The special role of this rugged line is long-term service under rough handling. ARROW ELECTRIC DIVISION,

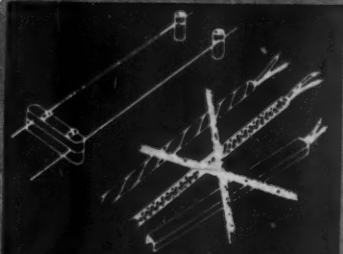
DISTRIBUTED THROUGH ELECTRICAL WHOLESALERS

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U. S. A.

PORCELAIN PROTECTED WIRING SYSTEMS

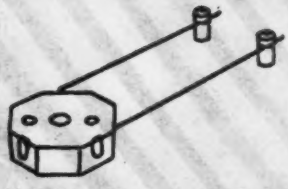


Only porcelain protected wiring provides a completely insulated outlet.

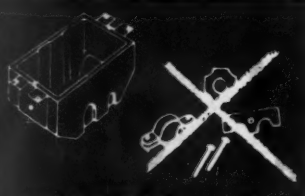


Low cost Rubber Insulated Wires supported on Porcelain Knobs, Tubes, and Cleats instead of expensive types of conductors.

Porcelain Protected Cable wiring also provides safe, dependable insulation.



Only Porcelain Protected Knob and Tube Wiring offers conductor separation, rapid heat dissipation, maximum safety, economy, and superior carrying capacity.



Porcelain Outlet Boxes require no cable clamps, connectors, miscellaneous screws or locknuts — they provide full insulation of the outlet where it is needed most.

★ ECONOMICAL LIBERAL ADEQUACY

for residential industrial · commercial · institutional buildings and rural installations

The increased number of branch circuits to provide plenty of properly located convenience outlets, requires a modern wiring system with ample carrying capacity. Porcelain Protected Wiring Systems provide larger carrying capacity without increased sizes of wire.

All this can readily be supplied with Modern Porcelain Protected Wiring Systems.

The same features of safety, durability, and economical adequacy necessary for modern residential wiring also apply to commercial, institutional, industrial, and rural installations. Commercial installations require the extra safety and adequacy provided by the Porcelain Protected Wiring System. Its superior safety is an absolute essential for institutional buildings and in industrial wiring where conductors must carry heavy current loads, the greater carrying capacity, economy, and safety of this system have proven particularly advantageous. In rural wiring, the safety and economy of the Porcelain Protected Wiring System has no peer for safety and economy of installation and operation.

★

★ ILLINOIS ELECTRIC PORCELAIN CO.
Macomb, Ill.

★ PORCELAIN PRODUCTS, INCORPORATED
Findlay, Ohio

★ SPECIALTY PORCELAIN WORKS
East Liverpool, Ohio

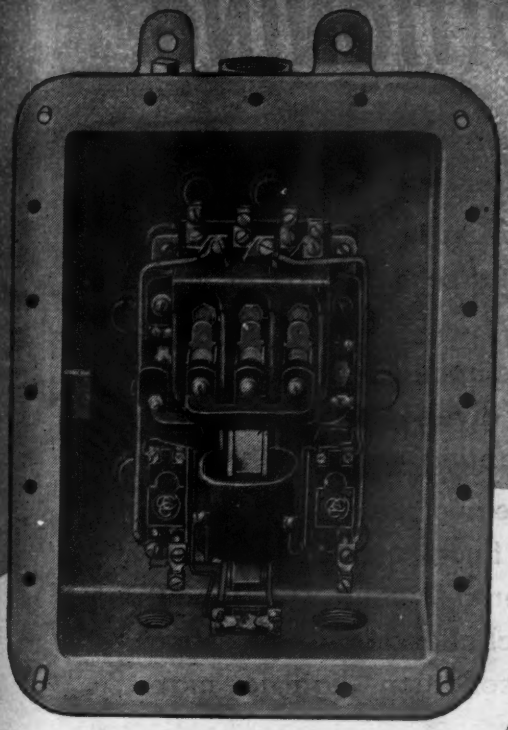
★ SUPERIOR PORCELAIN COMPANY
Parkersburg, W. Va.

★ UNIVERSAL CLAY PRODUCTS COMPANY
Sandusky, Ohio

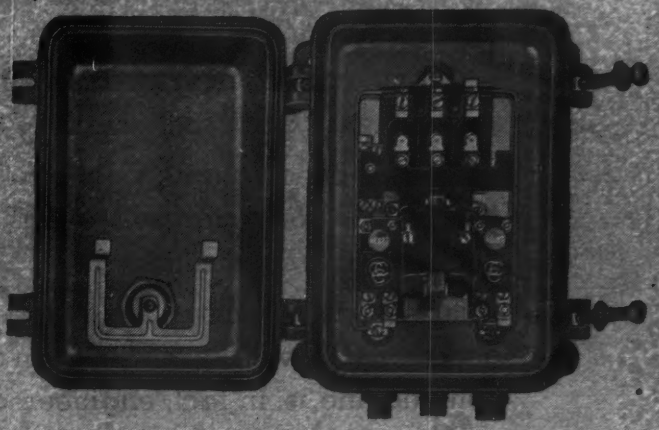
MODERN PORCELAIN PROTECTED WIRING SYSTEMS

"3C" Bulletin 6013 AC MAGNETIC STARTERS *available in sizes and cabinets to meet every requirement*

NON-REVERSING ACROSS-THE-LINE



Bulletin 6013, Size 2, Form MC Starter in NEMA Type 7 enclosure for Class 1, Group D hazardous locations.



Bulletin 6013, Size 1, Form MA Starter in NEMA Type 4 IC50-43 water-tight enclosure. Also available in NEMA Type 5 IC50-28 dust-tight enclosure.

Bulletin 6013, Size 2 Form MA Starter in NEMA Type 1 Enclosure.

"3C" BULLETIN 6013 MAGNETIC STARTERS *offer these "built-in" features*

1. Double break, silver-to-silver contacts.
2. Motor overload protection provided by eutectic alloy thermal overload relays.
3. Starter assembly mounted on steel sub-panel.
4. Hinged armature magnet.
5. Buttons in cover provide for externally resetting overload relays.
6. Non-carbonizing arc shields.
7. Form-wound operating coil.
8. "Start" and "Stop" buttons available in cover.
9. Ample space for wiring.
10. Entire assembly easily removed.
11. Heavy drawn steel or cast enclosures.
12. Wide range of sizes and cabinets for every need.

Bulletin 6013, Size 1, Form MA Starter in NEMA Type 1 Enclosure.

Our Distributors and District Offices will welcome your inquiries. Ask for Fully Descriptive Bulletin 6013.

THE CLARK CONTROLLER CO.

1146 EAST 152nd ST., CLEVELAND 10, OHIO • EVERYTHING UNDER CONTROL

MEETING THE CHALLENGE OF LIGHT-CONDITIONING

Real *light-conditioning* means much more than merely measuring "lumens" and "foot candles."

Like air-conditioning, light-conditioning is an exacting science which concerns itself with *qualitative standards*, as well as quantitative elements.

Like air-conditioning, too, it depends upon engineering principles to achieve true efficiency in any given installation. Light-conditioning is, in fact, *engineered lighting*.

Since 1857, as light sources progressed from oil, gas and incandescent to today's phenomenal fluorescent lamps, Frink has steadfastly specialized in *engineered lighting*. Throughout each lighting era Frink has met the challenge of the existing source with fixtures engineered to "condition" light for maximum benefit to its users.

Light-conditioning, therefore, is not new. But it will reach a dramatic climax in the post-war fluorescent era. Never before has there been a light source which lends itself so perfectly to scientific diffusion and distribution by Frink L-I-N-O-L-I-T-E fluorescent fixtures . . . *engineered for vision* to give you light-conditioning at its best.

FRINK

LIGHTING SINCE 1857

L-I-N-O-L-I-T-E

THE ULTIMATE IN FLUORESCENT LIGHTING

THE FRINK CORPORATION, Bridge Plaza North, Long Island City 1, New York

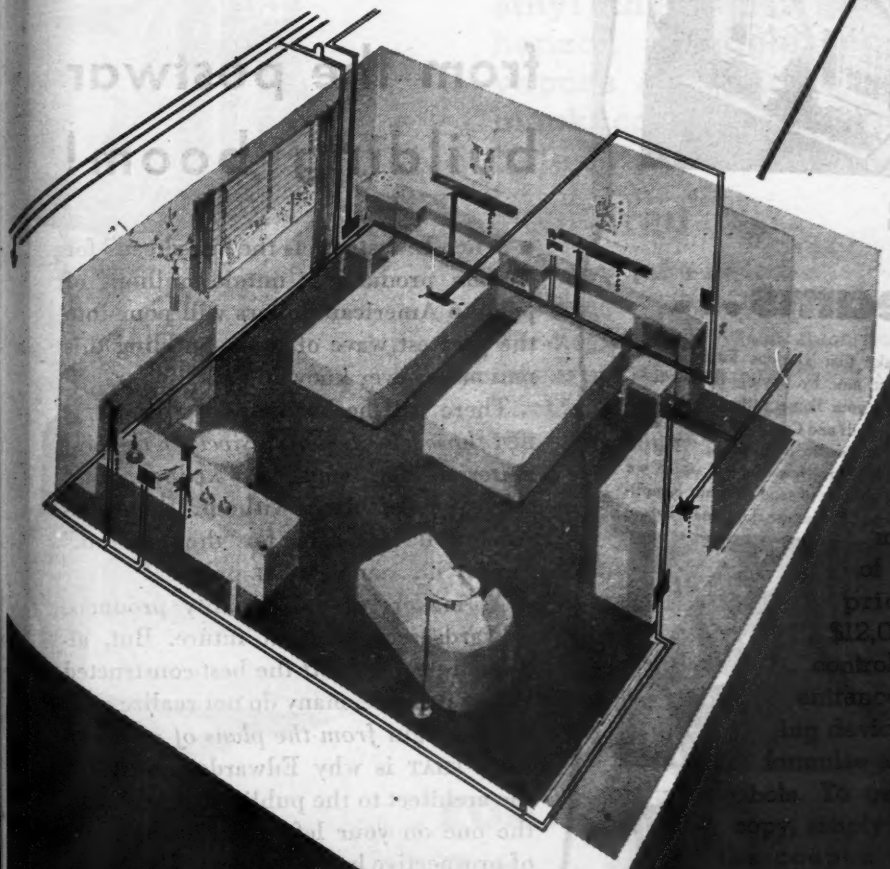
SUBSIDIARIES: Sterling Bronze Company, Inc. • Barkon-Frink Tube Bending Corporation

THIS IS *your* POSTWAR *lifeline*

Your postwar lifeline points directly to electrical living and better home wiring . . . which means more business and bigger profits for you.

Postwar home owners demand the benefits of reduced power rates and improved electrical appliances. Heavier line loads require adequate home wiring, which will give electrical contractors an unprecedented volume of this profitable type of business.

To help you take full advantage of this opportunity, your local Wesco Office has the materials you need for better home wiring and is prepared to give you reliable service in a hurry.



Westinghouse Electric Supply Co. **EC-6**
Box 25, Wall Street Station—40 Wall Street
New York 5, N. Y.

Gentlemen: **Please send me the new Westinghouse "Handbook of Better Home Wiring". I enclose $1 as payment in full.**

Name _____

Company _____

Address _____

City & Zone _____

State _____

Westinghouse
Electric Supply Company

For everything electrical call Wesco

The stuff of dreams...

● A dream is a fragile thing . . . a bubble which can so easily burst. Make sure that in some happy, not-too-distant day, your dream house will really be home for you and your family! Build towards it by buying and holding as many War Bonds as you possibly can. And plan your house with sound good sense and the help of an architect.

No one knows better how to incorporate your ideas into livable logic than the trained and skilled architect. His knowledge and his experience will help you avoid pitfalls . . . he will check overspending, save you heart-breaking disappointments — give you a home that is truly yours in every sense of the word.

Make that glorious future sure—start now by buying bonds, then plan your house with an architect. Edwards and Company has prepared an authentic little book, "How to Plan Your New Home," which we would like to send with our compliments. Please use the coupon below.

Edwards and Company, Box 390, Norwalk, Conn.

Please send a free copy of the booklet, "How to Plan Your New Home."

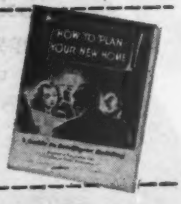
AH 645

Name_____

Street_____

City_____ State_____

(Save Postage—Paste Coupon on Penny Postcard)



Plan your house now!
START RIGHT—
WITH AN
ARCHITECT.

EDWARDS
ELECTRICAL SIGNALING
Bells · Chimes · Telephones · Alarms
for Homes, Offices, Schools, Hospitals

NOT EVERY FIRM WILL PROSPER

from the postwar building boom!

● When Industry gets the "go-ahead" for *civilian* production, untold millions of pent-up American dollars will pour into the greatest wave of home-building this nation has ever known.

There will be business for you all . . . BUT *those who deal exclusively in the best materials will make the* REAL *profits!* After years of "doing without," the American public is starving for "the real stuff." Supply it . . . and YOU'LL prosper!

As makers of only quality products, Edwards sees a bright future. But, although people *want* the best-constructed homes possible, many do not realize such homes begin *from the plans of an architect!* THAT is why Edwards has "sold" the architect to the public, using ads like the one on your left—reaching millions of prospective home-builders. The Architect will specify only the best electrical equipment for his clients' homes. He knows of this campaign . . . *and he already knows Edwards equipment is tops!*

So, you see, our "Architect" ads are actually working for you who handle the Edwards line!

EDWARDS and COMPANY
NORWALK, CONN.
In Canada: Edwards & Co., Ltd.

CROUSE-HINDS
Thermostat Condulets
For Heating, Air Conditioning, Refrigeration

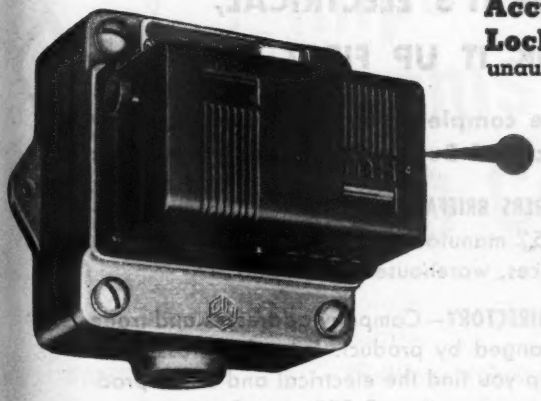
FOR HAZARDOUS LOCATIONS

Explosion-Proof and Dust-Tight—Suitable for use in atmospheres containing ethyl ether vapor; gasoline, naptha, petroleum, benzol, alcohols, acetone, lacquer solvent vapors and natural gas; metal dust; carbon black, coal or coke dust; grain dust; combustible fibers.

Type HRC

Mercury tube switch.
Threaded flame-tight cover.
Through feed ½-inch union hubs. Either hub can be capped.
Accurate thermometer for indicating room temperature.
Locking arrangement can be furnished to prevent regulating by unauthorized persons.

Listed in Condulet Catalog No. 2500, Section 85, Page 50-3.

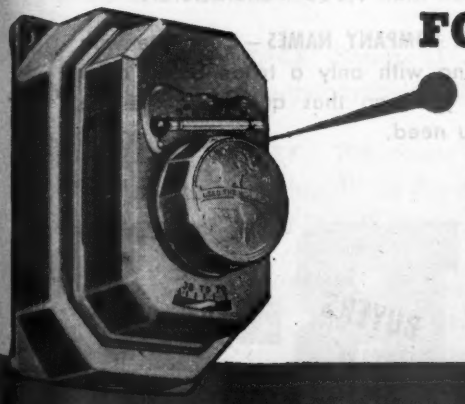


Type HR

Contactor snap switch.
Ground surface flame-tight cover.
Reversible. ¾-inch hub can be at top, bottom, or either side.
Accurate thermometer for indicating room temperature.
Regulating knob removable to prevent unauthorized regulating.

Listed in Condulet Catalog No. 2500, Section 85, Page 50-4.

FOR NON-HAZARDOUS LOCATIONS



Type FHRC

Mercury tube switch.
Through feed ¾-inch hubs flush with top and bottom of body. Removable plug for either hub.
Accurate thermometer for indicating room temperature.
Locking arrangement can be furnished so thermostat can only be regulated by authorized persons.

Listed in Condulet Catalog No. 2500, Section 50, Page 22B..

A Nationwide Distribution Through Electrical Wholesalers

CROUSE-HINDS COMPANY
SYRACUSE, N. Y., U.S.A.

Offices: Birmingham Boston Chicago Cincinnati Cleveland Dallas Denver Detroit Houston Indianapolis Kansas City Los Angeles Milwaukee Minneapolis New York Philadelphia Pittsburgh San Francisco Seattle St. Louis Washington
Resident Product Engineers: Albany Atlanta Charlotte New Orleans
CROUSE-HINDS COMPANY OF CANADA, LTD., *Main Office and Plant:* TORONTO, ONT.

E-B-R CAN HELP YOU...

... just as it has helped thousands of other busy electrical men. E-B-R is the *only* annual reference published in, and for, the electrical industry. It is designed with *your* procurement problems on mind—designed to make your work easier, and to save you time and money.

The manufacturers' Briefalog Section is a particularly valuable feature. It includes 527 pages of product data, but due to the unique *Briefalog method of treatment, these pages are equivalent to over 1,500 pages of catalog data handled the old way. You see, the Briefalog was originated by E-B-R. It is the modern way of presenting product data—with essential material all there, but excess "sales talk" or over-long description and detail *left out.*

Please don't monopolize your copy of E-B-R

Show it to other key men in your company, and let them use it, too. Under government paper restrictions, we can distribute only a limited number of copies. You will help us to help you by sharing your E-B-R.

IF IT'S ELECTRICAL, ...LOOK IT UP FIRST IN E-B-R

Now more complete than ever before, your 1945 Electrical Buyers Reference gives you:

MANUFACTURERS BRIEFALOG SECTION—Condensed catalogs of 357 manufacturers. Product specifications, branch offices, warehouses, etc.

CLASSIFIED DIRECTORY—Company addresses and trade names, arranged by product. Extensive cross-reference to help you find the electrical and allied products made by more than 3,500 manufacturers.

INDEX OF TRADE & COMPANY NAMES—Complete with addresses. Starting with only a trade name or a company name, you can thus quickly locate the product data you need.

You'll find it, if you look first in...

E-B-R ELECTRICAL BUYERS REFERENCE

*Briefalog—E-B-R's own original version of modern condensed cataloging.

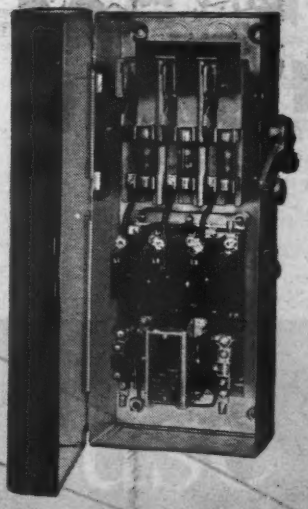
McGRAW-HILL PUBLISHING COMPANY, 330 WEST 42nd ST., NEW YORK 18, N.Y.

3 important advantages in this installation of Square D Combination Starters

SAVES TIME Disconnect Switch and Magnetic Starter are housed in one enclosure—thus saving mounting and wiring time.

CONSERVES SPACE Square D Combination Starters require substantially less space than individually mounted switches and starters.

INCREASES SAFETY The cover of the enclosure is interlocked with the operating handle of the disconnect. Thus, the cover cannot be opened on a "live" starter.



Write for Bulletin 8538 which gives details and illustrations of complete line. Address Industrial Controller Division, Square D Company, 4041 North Richards Street, Milwaukee 12, Wisconsin.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

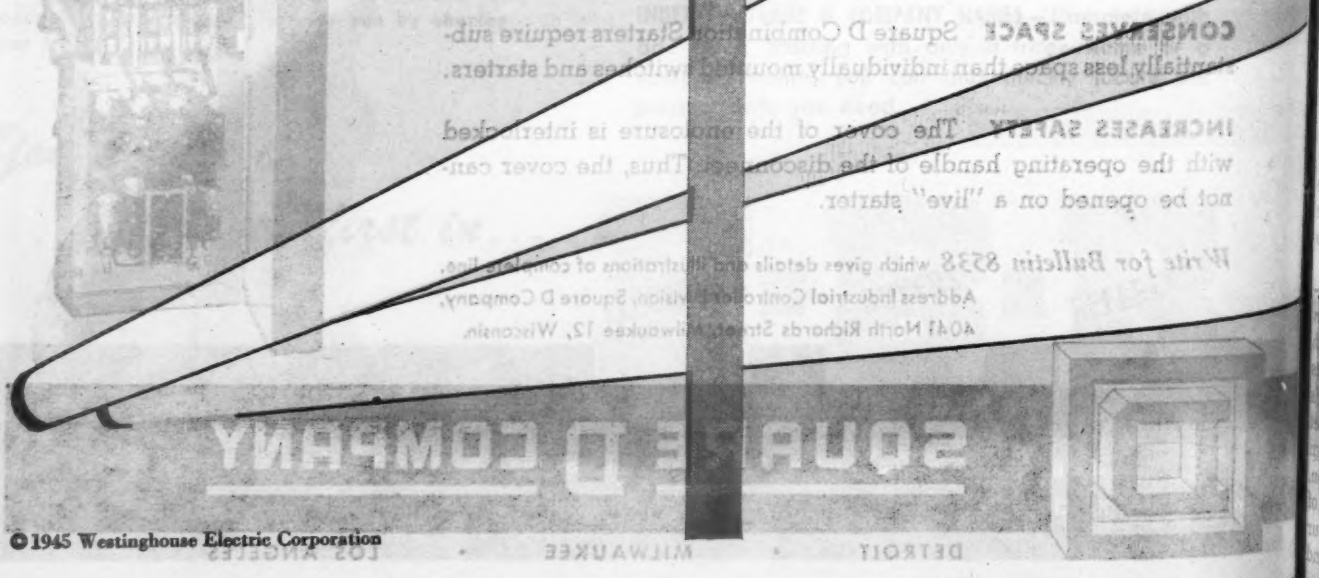
THE LAMPS ARE

...the results are better

Eyes like these must be sure. And they are sure—without strain or fatigue—because See-ability makes every adjustment clear and sharp, helps maintain high speed efficiency.

Draughting is an art that reaches its peak only under the finest lighting conditions. Westinghouse Fluorescent Lamps provide the See-ability that work like this demands.

A misplaced wire—a wrong connection and—somewhere a costly error. Accuracy that prevents errors must have the See-ability of Westinghouse Fluorescent Lamps.



© 1945 Westinghouse Electric Corporation

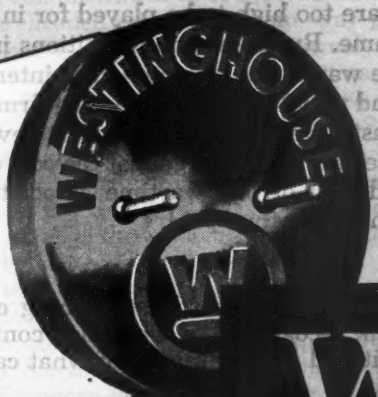
WESTINGHOUSE

See-ability

Today—in every branch of industry—Westinghouse Fluorescent Lamps are meeting industry's lighting needs—are providing invaluable aid to every seeing task where speed and precision are prime production factors. Alert dealers are building prestige and profits on the firm foundation of an adequate supply of these dependable lamps.

Throughout industry—wherever you go—industry is demanding top grade lighting. Sell Westinghouse Fluorescent Lamps and meet this demand—completely!

Office workers respond to the better See-ability of Westinghouse Fluorescent Lamps. More contentment—more speed—fewer mistakes when the lighting problem is solved.



Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

MAZDA LAMPS FOR SEE-ABILITY

RUSSIA AND AMERICA

ALLIES—or else . . .

VICTORY in Europe was won only through the combined endeavor of the United Nations. Only through sustained joint effort can the fruits of that victory be reaped.

Without disparaging the truly heroic contributions of others, three of the Allies may fairly be credited with having made the major contributions to victory over the European Axis—the United Kingdom, Russia, and the United States. The close accord of these three nations is no less crucial to the accomplishment of the tasks that remain.

First of these is the war against Japan. It still requires winning. Even without any help from others, the United States could make good this victory, but the war's duration will be speeded by the marshaled effort of the United Nations.

Next, and not less important, is the task of establishing a basis for enduring peace. In this struggle our enemies are more formidable than any we have faced—national ambitions, prejudices, suspicions and distrusts, the staggering burden of tradition and debilitating cynicism born of past failure, the cleaving wedges of divergent languages, thought patterns, economic creeds and procedures—an array of difficulties as baffling as fog and as formidable as a deluge. They can be vanquished only by a continuance of the working accord between the United States, Russia, and Britain that was forged on the anvil of European conflict.

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This high appraisal of the decisive importance of the Big Three in determining the destiny of the United Nations organization, in no way depreciates the importance of the role to be played by France, by China, or the other freedom-seeking nations represented at San Francisco. All of us are committed to the building of a genuinely representative security organization in the conviction that by such means alone can we possibly achieve a just and lasting peace. But the strength of any international machinery will depend upon the validity of Russian-British-American cooperation. If these three are able to achieve substantial harmony of aim and procedure, a world organization that includes them can operate with effective coherence. If they pull apart, the United Nations will break up into competing and jealously hostile blocs.

This is inevitable because of the sheer weight of these three nations in the world's affairs. Between them they account for perhaps half of the world's income and from two-thirds to three-quarters of its industrial output. Once Japan has been crushed, they will control an overwhelming preponderance of the world's armed might. Each of them will wield military power on a scale quite beyond the power of any embryo security league to hold in check. Only if all three are resolved to keep the peace and to enforce it through the Security Council, can that body hope to accomplish its aim.

Although there is a tendency on both sides of the Atlantic to indulge somewhat recklessly in mutual criticism, the ties between Britain and America are too firm to be severed by any foreseeable strain. But that has not been true of our relations with Russia. Even while fighting a war in which our respective ways-of-life were at stake, the inestimable services of each to the other were rendered as friendly but independent associates rather than as fully trusted partners. Now again, as we approach the difficult and vitally important task of building a world organization and of devising a European peace, the task of our delegates is complicated by national attitudes under which each hopes for the best from the other, while fearing the worst.

But the stakes for us both—and for the rest of the world—are too high to be played for in a diplomatic poker game. Russia has no inhibitions in demanding what she wants, and our own vital interests must be stated and upheld with undeviating firmness. Yet we both must face the stark fact that few advantages that either nation might gain at the cost of dissipating the good will of our wartime association could be worth the price thus paid.

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The first steps toward establishing confidence lie in a frank recognition of what may contribute to the lack of it and in a definition of what can be done to restore it.

1. *Probably the greatest single area of reciprocal distrust between Russia and our own country is based on the fear of each that the other may try to interfere with its domestic, economic, and political affairs.* Each purports to see the beam of meddlesome intervention in the other's eye, while it ignores the mote in its own. Thus the Soviet Union remembers that we participated in the foreign military intervention at the time of her civil revolution, and afterwards lent our support to successive boycotts of her trade, of her gold, and of her credit needs. For our part, we remember the Soviet Union's doctrine, and

aggressive support, of revolutionary international communism.

We feel that Russia should find satisfactory evidence of our present willingness to have her develop her internal institutions as she will in the aid that we have given her during the war, and in the record of our good-neighbor policy as applied to Latin America. She, no doubt, resents our lingering suspicions in the face of her declared policy of 1941 to refrain from any attempt to influence the political or economic structure of foreign nations. Certainly, each of us will need the repeated reassurance that can come only through sustained performance by the other in the years ahead. Meanwhile, much will be gained if each will give to the other's good faith the benefit of the doubt, while it scrupulously guards its own conduct to avoid even the appearance of backsliding.

2. *A second zone of suspicion is created by those measures which each of us interprets as natural and necessary bulwarks of national security when they are our own, but as evidence of dangerously aggressive imperialism when taken by the other.* In our view, at least, such demands as we have voiced for island trusteeships or for other naval bases appear mildly conservative as compared with Soviet claims for annexation of territory and for a general orbit of influence, under governments friendly to her, throughout eastern Europe in particular.

There can be no easy solution to that problem. Bi-focal vision, by which one nation can look through a second lens ground to the prescription of another, seldom is achieved in international affairs. The success of the San Francisco Conference will provide a mechanism for international definition of principles and procedures which at least might relieve the inevitable strains. Most important will be the record of how each of us proceeds in our respective courses of action. Soviet performance thus far is highly unsatisfactory to us. While we have taken pains to clear our procedure with her, she has taken action in the Baltic, in Austria, and in Poland without even advance notice to us.

A major test of our ability to cooperate may be found in the Allied administration of conquered Germany. The proposed four-headed control of a four-way partitioned nation promises to be at best an extremely awkward mechanism of administration. At worst, it can result in continuous and dangerous bickering between the representatives of Britain, France, the United States, and Russia in the Berlin coordinating center, and in hopelessly divergent procedures in their several zones of administration. There will be a compelling need for all of us to exercise all of the wisdom and cooperative resolve that we possibly can muster.

3. *A third testing ground for the future of American-Soviet relationships will be defined by the course of Russia in our continuing war with Japan. We are not unmindful of the toll paid by the Soviet Union in its magnificent European war effort. But we still are locked in a desperate struggle with an enemy that exemplifies the Fascism which America and Russia equally denounce. And that war is being fought in an area where Russian interests are importantly at stake.*

Russia has an extraordinary opportunity to create good will by throwing her weight speedily and effectively on our side. There is no doubt but that the final Pacific settlement will generate problems comparable with those of the European peace, but it is equally certain that the continuation of the European comradeship in arms can do much to promote an enduring and confident postwar friendship.

4. *A fourth, and highly important, potential source of suspicion and irritation is the intellectual blockade that the Soviet Union has maintained against the free flow of travel, intercourse, and exchange of ideas.* We can understand the genesis of this policy and the reasons for its continuance while Russia entertained a constant fear of attack by powerful enemies. But the sustained perpetuation of such a quarantine by so strong a nation as the present U.S.S.R. could not be accepted as a protective measure. Inevitably it would generate suspicion that it was rather an instrument of nationalistic isolation or even of contemplated aggression. A way-of-living, at arm's length, with a nation that maintains such intellectual quarantines is possible; any whole-hearted partnership of effort is quite impracticable.

5. *Trading between a free-enterprise nation and one that operates all foreign commerce as a government monopoly can give rise to many frictions.* That subject is too complicated for exposition here. Suffice it to say that, while difficult, it is not impossible to conduct such trade with mutual advantage. We are in a position to help Russia greatly with her program of industrial rehabilitation and expansion at great saving of cost in terms of her current scale of living. In return, we must have assurance that her government monopoly trading will be conducted for commercial rather than political ends, and that it will be used to encourage rather than to restrict multilateral and non-discriminatory world trade.

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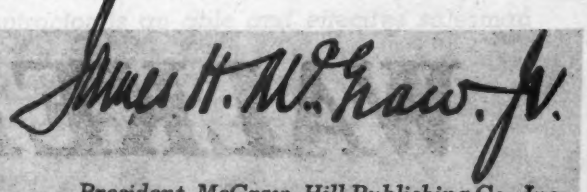
This is a representative list of the major areas in which misunderstanding and distrust may be generated, or allayed, in Russian-American relationships. No doubt, an equally honest list drawn by a citizen of the Soviet Union would be more heavily weighted by those features of our behavior which irritate and stimulate distrust on their side. If such a catalog were to be presented, it should receive our most searching and responsible consideration.

For it is of utmost importance that our two nations, in concert with the other United Nations, learn how to get along in mutual confidence and respect. Our understanding of each other now is so imperfect that our negotiations are punctuated with continuous irritations over *little issues*. This, inevitably, will continue until such matters are submerged in the general confidence that can be achieved only through satisfactory settlement of the *big issues*. We must succeed in this, or the defeat of Japan will merely mark the end of the Second in a series of World Wars.



President, McGraw-Hill Publishing Co., Inc.

THIS IS THE 36TH OF A SERIES

MOISTURE has no effect on...

WALKER'S TW*

THERMO-PLASTIC INSULATED WIRE

WIRE WITH WALKER

Complete resistance to moisture, in all its forms, is afforded by the thermo-plastic insulation used on Walker TW Small Diameter Building Wire. Thus it is ideal for applications where there are wet soils, damp walls and floors, and surface raceways where wires are exposed to vapors and condensation.

And not only moisture, Walker's TW also strongly resists acids, alkalies and oil. It has high dielectrical and mechanical strengths, requiring less thickness of insulating material, and thus enables raceways to carry more wires and wattage.

Existing raceways can be easily rewired with Walker's TW. Its slick, smooth surface permits easy pulling, and its toughness withstands bending around corners. Stripping and splicing can be done quickly and with ease.

Walker's TW is supplied in standard colors, and in sizes from 18 to 4/0. Ask your Walker Distributor for prices and delivery information, or write to WALKER BROS., Conshohocken, Pa.

WALKER'S TW is approved by the Underwriters' Laboratories (1940 Code, Section 3035) in sizes from 14 to 4/0 inclusive for use in raceway systems, such as (1) Underground, (2) In concrete slabs or masonry in direct contact with the earth, (3) In wet locations, (4) Where the condensation and accumulation of moisture within the raceway is likely to occur.

While the use of T or TW in new construction is now permitted under emergency regulations, the proposed new N. E. Code will recognize its universal use.

* **The Underwriters' Laboratories, Inc., have adopted the term "Thermo plastic" for "Synthetic" insulated wire and have substituted the type letters T and TW for the old types of SN and SNW.**

JUNE . . . . at a Glance

FOLLOWING VE DAY, Eastern Editor Berlon Cooper visited his former haunts in WPB to round up the "Period One" picture on war regulations. His down-to-earth summary on the current situation leads off "In the News", page 164, this month. We held it open until press time to bring you up-to-date, last minute developments.

★

AMONG THE BIGGER electrical construction projects of recent months is Utilities Engineering Company's job at Alan Wood Steel in Conshohocken. Load-center substations are used providing blocks of a-c or d-c power spotted strategically around the plants. One of several unusual features is the tie circuit linking two 1000 kw. mercury arc rectifiers and a 1000 kw. generator. You will find details and pictures beginning on page 59, "DC and AC Load-Center Distribution."

OPPORTUNITIES IN RURAL WORK will break with the progressive release of critical materials in the coming months. A round up of the market and its potential opportunities is presented in a challenging article, "Contractors and Rural Electrification" on page 64.

★

MORE GOOD DATA on farm wiring will be coming along in future issues, and to get an idea what all-out electrification can do on a farm, read the story of Seabrook Farms in southern New Jersey, page 66.

★

STARTING OFF a new motor shop from scratch gives a free hand in shop layout and in the choice and arrangement of shop machinery. Romanoff Electric Motor Service, Inc., in Toledo, grew on paper long before the first coil winder was purchased. One of the country's newest shops, it is based on a "free work flow" principle. The complete details of equipment and layout are given in the article, "Designed for Service", on page 68.

★

MORE THAN a billion dollars are earmarked for future school construction to start as soon as construction controls will permit. About 5000 major school structures are involved. And school lighting promises to be in the forefront of the modern techniques due for extensive development in this program. Fifth in a series of articles on modern lighting methods, "School Lighting Techniques", page 75, offers a compact round-up of modern school lighting methods for your own planning.

★

INTRICACIES of tax details are best left to the CPAs. But the carry-over and carry-back provisions of our present tax structure can involve important policy decisions. And decisions made today can bring significant tax benefits under some circumstances. An authoritative article on this subject has been prepared by the Research Institute of America. You will find it on page 78. It is must reading for everyone responsible for executive planning today.

★

HONEST—we don't really mean it, when we say contractors aren't salesmen. In our April editorial, "Too Busy To Sell", three anecdotes pointed up obviously (we thought) vital sales work by a contractor. In each instance the guy denies he is a salesman. Some folks missed the irony and pinned our ears back. For them and others who may have misunderstood, here is what we were getting at—The contractor is an able and effective salesman whether he calls himself a salesman or not. Furthermore, he is the most vital force in creative market development in the electrical industry.

Because of the basic importance of adequate wiring to the entire electrical industry, Anaconda is presenting messages like this in a wide list of national publications.

DOES THE LIFE-LINE OF YOUR ELECTRICAL FUTURE FORETELL WIRE-ITIS?

IN PLANNING a future electrified home, it's human to focus on the appliances—air-conditioning—new types of heating—an advanced range—a new refrigerator—an exhaust fan—and a host of other easier-living devices.

But don't risk cramping appliance operation. Don't invite the nuisance of Wire-itis. You'll need wiring service out of all proportion to past ideas—more and heavier wire, more circuits, more outlets. Don't wait until Wire-itis forces expensive alterations.

Manufacturers! You're equally concerned with postwar Wire-itis. Make sure electrical capacity—your wiring set-up—is in line with forecasts of huge increases in electrical usage.

Call in your consulting or plant power engineer, electrical contractor, or power salesman. They'll agree Wire-itis will cost a lot more than *foresighted* wiring. 4504

✻ Failure of wiring to meet expanded peacetime demands.

ANACONDA

ANACONDA WIRE & CABLE COMPANY

GENERAL OFFICES: 25 Broadway, New York City 4

Subsidiary of Anaconda Copper Mining Company

CHICAGO OFFICE: 20 North Wacker Drive 6 • Sales Offices in Principal Cities

✓ *Check Your Wiring Plans Before They Check You!*

CAN FARMERS AFFORD CHEAP WIRING?

With renewed programs for rural electrification, everybody wants to give the farmers low cost wiring. We are heartily in sympathy with the basic idea. Our industry has a real responsibility to give him the most in useful, reliable and convenient electrical service for his wiring dollar that we know how.

But let's keep our planning straight. The attitude that farm wiring is a poor relation of the residential wiring business is so prevalent today that there is reason for grave concern over the whole future of rural electrification. Today we are busy designing and planning for low wiring costs before we have learned, as an industry, to wire a farm properly at any price.

Agriculture is big business. Farms are highly organized, integrated and mechanized today. They are not a depressed element of the economy. And they are just as dependent upon their mechanical facilities as any industrial plant. Come six o'clock and the milkers won't work because the goat has lunched on the tasty little plug receptacles we provide is just as much a production emergency as an assembly line breakdown—and the nearest electrician halfway across the state.

Any industrial wiring problem gets the undivided attention of corps of engineers and designers. Farm wiring, with a market in box car figures, gets the stripped-down leftovers of house wiring design. And, in our opinion, the sole difference is an attitude of mind. We have emphasized cheapness to the exclusion of obviously needed engineering development.

Another common attitude is that farm wiring can be relegated to men of indifferent skill to save labor costs. Just why the farmer should be expected to expose his capital structure to jerry wiring any more than the factory owner is mysterious logic beyond our understanding.

What does the farmer want of wiring? He wants efficient service. He wants economical convenience. He wants the utmost reliability. But we can't expect *him* to write the specifications, to solve the technical problems nor to foresee the future demands on the wiring job he buys. Why then are we too busy keeping the cost down to tackle the real problems? The farmer can't afford cheap wiring. Nor can we afford to sell it to him.

Wm. F. Stuart

Electrical Contracting—
JUNE, 1945

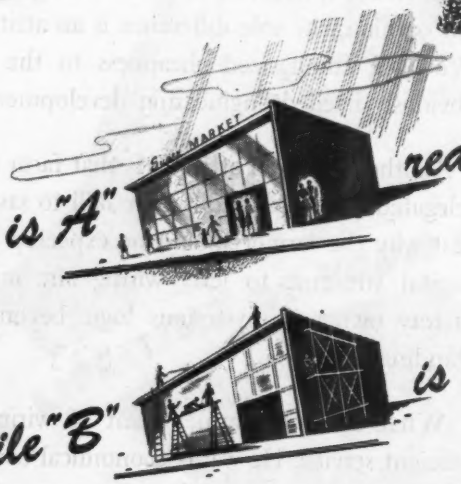
Another boost for your business

Here's the newest of the Graybar advertisements appearing in *The Architectural Forum*, whose more than 43,000 copies monthly are read by upwards of 172,500 leaders in the building field. This series of advertisements tells the story of your qualifications and services and urges architects to check with you early in the stages of design.

The local Graybar Man is ready to serve you with first-quality electrical supplies and last-minute product information.

4548

Why is "A" ready for use . . . while "B" is incomplete?



BECAUSE John Watts Electrical Contractor WAS CONSULTED EARLY

Consider two buildings of identical appearance. Plans for both were begun at the same time. Yet one is ready for use while the other still is days — perhaps weeks — from completion. Why?

Because, in the initial stages of design of building "A", the architect supplemented the electrical know-how of his engineer and specification writer with the specialized knowledge of "John Watts" — a qualified electrical contractor.

To expedite the construction of every building you design, check with "John Watts" early. His organization has the latest product information and the installation know-how — plus on-the-spot knowledge of local codes, power supply, and working conditions — to give your electrical people valuable help on plans for wiring, lighting, signaling, and power-driven apparatus — for industrial, commercial, or residential buildings.

Well informed electrical contractors — the "John Watts" everywhere — obtain equipment and supplies via Graybar. This sound practice means you can count on them for the newest and best in "everything electrical". Graybar Electric Company, Graybar Building, New York 17, N. Y.

GraybaR Everything Electrical GraybaR ELECTRIC COMPANY

QUALITY SINCE 1869 * REG. U.S. PAT. OFF.

IN OVER 80 PRINCIPAL CITIES

D-C and A-C Load-Center Distribution

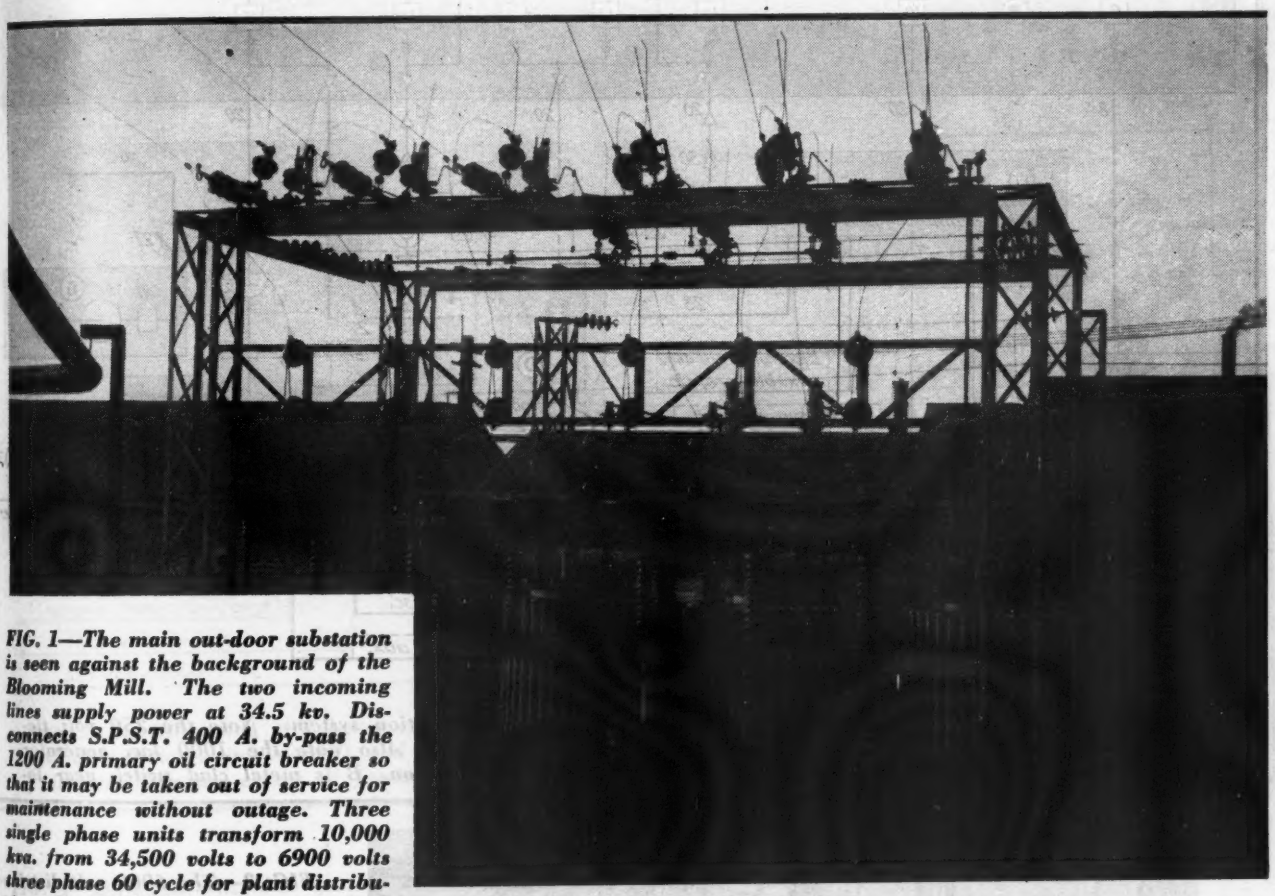


FIG. 1—The main out-door substation is seen against the background of the Blooming Mill. The two incoming lines supply power at 34.5 kv. Disconnects S.P.S.T. 400 A. by-pass the 1200 A. primary oil circuit breaker so that it may be taken out of service for maintenance without outage. Three single phase units transform 10,000 kva. from 34,500 volts to 6900 volts three phase 60 cycle for plant distribution. Six 750 MCM conductors in four inch fiber duct are run underground to the metal clad switchgear in the Blooming Mill motor room.

Rectifier load-center substations are paralleled with M-G sets, rectifier auxiliaries are inter-connected, and 6900 volt distribution is run underground in fiber duct. These are high-lights of an electrical construction job by Philadelphian Howard L. Miller's Utilities Engineering Co.

By Robert E. Miller

LOAD-CENTER substations, providing blocks of a-c or d-c power wherever required are spotted throughout the plants of the Alan Wood Steel Company, Conshohocken, Pa. The electrical construction at Alan Wood involved the complete electrification of the Blooming Mill, the Plate Mill, and the Open Hearth.

The 250 volt direct-current requirements were of such magnitude that a 1000 kw. mercury arc rectifier was installed in the Blooming Mill motor room and another at the Open Hearth substation with a tie-bus between the two. To provide additional capacity to meet the projected d-c load, a 1000 kw. generator was paralleled onto the tie-circuit. Thus, under normal operation with all tie-switches closed, d-c power flows in either direction over the tie to meet the peak requirements on the respective busses. Power supply for the m-g set was obtained from excess 25 cycle 2300 volt capacity in the Power House.

Another interesting point in the design is the interlocked supply facilities for the rectifier auxilliaries which include vacuum pumps, electronic control circuits, water circulating pumps, etc.

EQUIPMENT SCHEDULE

1—Incoming 34.5 kv. lines to main outdoor substation.
2—Lightning arresters 34.5 kv.
3—Motor operated air-break switches 3 P.S.T. 400 A.
4—Disconnect switches S.P.S.T. 400 A.
5—Oil circuit breaker electrically operated 1200 A.
6—Air break disconnect switch 3 P.S.T. 400 A.
7—3—3333 kva. transformers 33000/6900 v. 3 ph. 60 cy.
8—6—750 MCM V.C.L.C. 15 kv. in 4 in. fiber duct.
9—Main supply breaker—1200 A.
10—1200 A. breaker for Blooming Mill 440 v. aux. power.
11—1200 A. breaker for Plate Mill 6.6 kv. motor.
12—Dynamic braking breaker.
13—Dynamic braking breaker.
14—1200 A. breaker for Plate Mill 6.6 kv. motor.
15—1200 A. breaker for Blooming Mill rectifier.
16—Dynamic braking breaker.
17—1200 A. breaker for Blooming Mill motor M-G set drive.
18—1200 A. breaker for Open Hearth rectifier.
19—1200 A. breaker for misc. light and power.
20—1—3/C 250 MCM V.C.L.C. 15 kv. in 4 in. fiber duct.
21—750 kva. 3 ph. 6600/440 v. load center transformer.
22—Amplidyne M-G set: 15 hp. ind. motor, 3 kw. 250 v. d-c generators.
23—440 v. supply to rectifier auxiliaries.
24—3—5 kva. 440/220 v. transformer.
25—Automatic throw-over panel.
26—3—10 kva. 6600/220 v. transformer.
27—Fused disconnect.
28—6600 volt supply to rectifier auxiliaries.

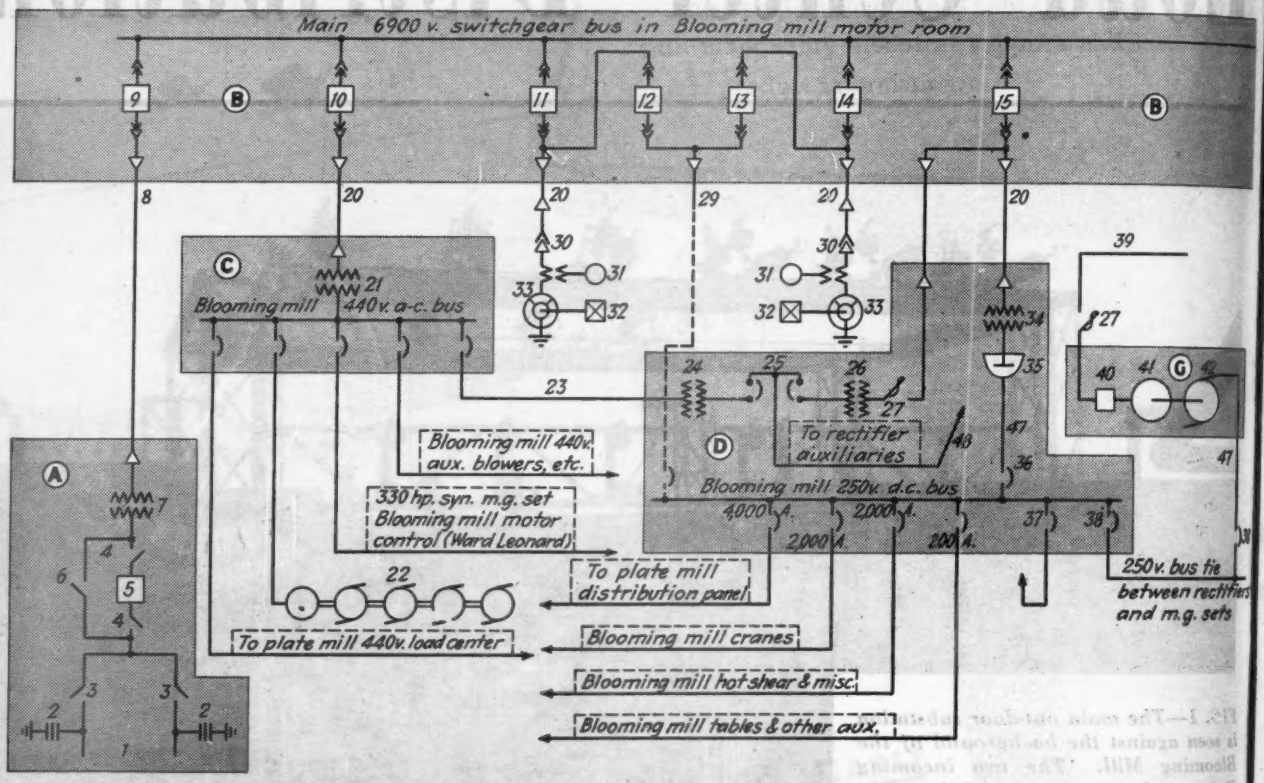
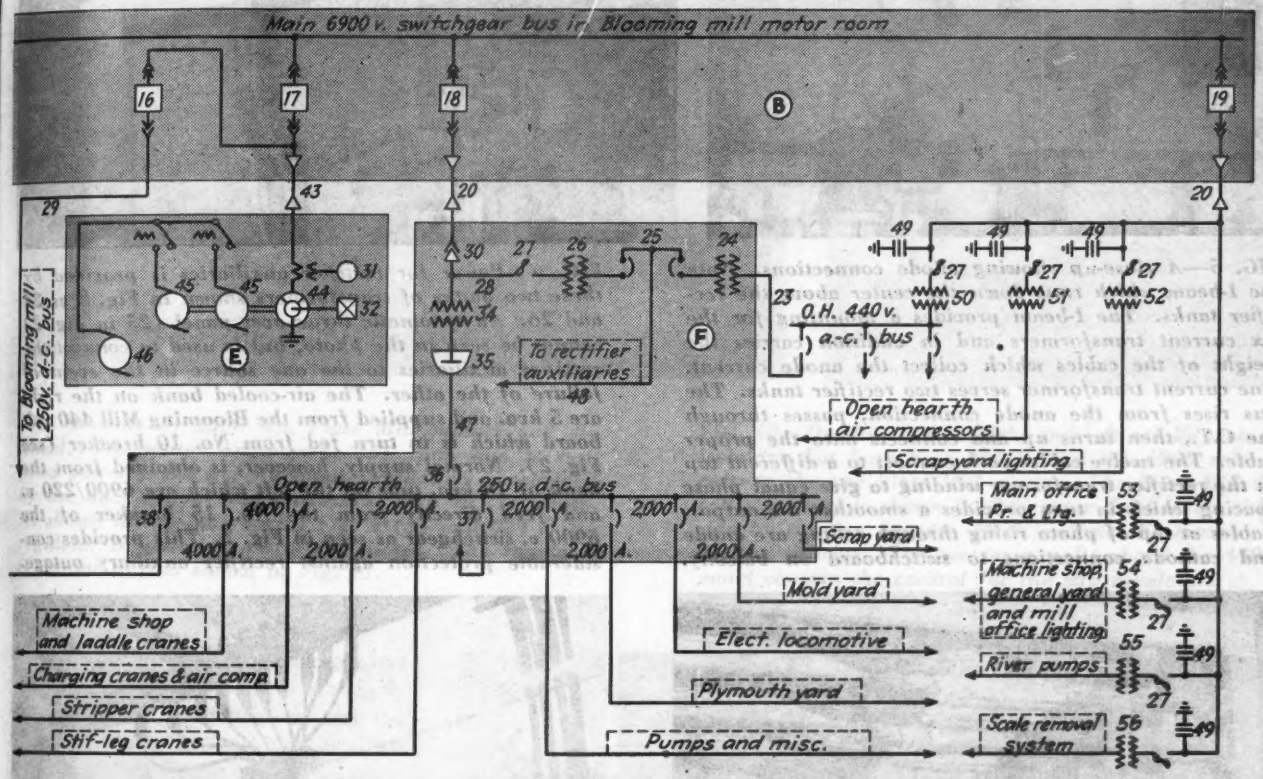

Main 6900 v. switchgear bus in Blooming mill motor room
Blooming mill 440 v. a-c. bus
Blooming mill 440v. aux. blowers, etc.
330 hp. syn. m.g. set Blooming mill motor control (Ward Leonard)
To rectifier auxiliaries
Blooming mill 250v. d.c. bus
4,000 A.
2,000 A.
2,000 A.
200 A.
To plate mill distribution panel
250v. bus tie between rectifiers and m.g. sets
To plate mill 440v. load center
Blooming mill cranes
Blooming mill hot-shear & misc.
Blooming mill tables & other aux.

FIG. 2—Single line diagram of Alan Wood Steel's electrical distribution system. Note the 250 volt tie-bus between the two direct-current load center substations D and F. Also note the 1000 kw. generator (42) which parallels onto the tie-bus. A is the main outdoor substation. B is metal clad switch gear lo-

FIG. 3—The 6900 volt distribution circuits fan out from this metal clad switchgear to the various direct- and alternating-current load center substations. The first cubicle contains metering, relaying and substation control equipment; the second contains the main switchgear bus breaker from the outdoor substation. Cubicles 5, 7 and 9 contain the dynamic braking circuit breakers which are shown in Fig. 2, as 12, 13 and 16. The other seven cubicles contain 6900 volt distribution feeder breakers. All breakers are rated 1200 A. This twelve-cubicle gear unit is represented in Fig. 2 above as B, located in the B. M motor room.

EQUIPMENT SCHEDULE

29—2—500 MCM 600 v. in 2½ in. conduit.
30—Isolators.
31—Slip regulator motors supplied from series transformers.
32—Slip regulators.
33—Plate Mill wound rotor motors 2500 hp. 251 rpm. 6.6 kv.
34—Rectifier transformer 1260 kva. 6600/250 v.
35—Twelve-tank rectifier 1000 kw. 250 v. d-c.
36—6000 A. 250 v. cathode breaker.
37—6000 A. 250 v. anode breaker.
38—4000 A. 250 v. d-c tie breakers.
39—25 cycle supply from power house bus.
40—25 cycle control for M-G set motor drive.
41—Synchronous motor 1600 hp. 2300 v. 25 cy.
42—D-C generator 1000 kw. 250 v.
43—3—1/C 500 MCM V.C.L.C. 15 kv. in 3½ in. fiber duct.
44—Blooming Mill M-G set motor 3000 hp. 505 rpm. 6.6 kv.
45—D-C generators 1500 kw. 505 rpm. 750 v.
46—Blooming Mill reversing motor 3500 hp. 50/120 rpm.
47—D-C mains 6—1000 MCM per leg (12 total per circuit).
48—3—#2/0 in 2 in. conduit.
49—Lightning arresters 9000 v.
50—3—100 kva. load center transformers 6600/440 v.
51—3—100 kva. L-C transf. 6600/440 v.
52—2—15 kva. ltg. transf. 6600/220/110 v.
53—1—50 kva. ltg. transf. 6600/220/110 v.
54—2—100 kva. 6600/440/220 v. 2—50 kva. 6600/220/110 v.
55—1—500 kva. 3 phase L-C transf. 6600/440 v.
56—1—750 kva. 3 phase L-C transf. 6600/440 v.



cated in the Blooming Mill motor room along with the 440-v. distribution switchboard C, the d-c substation with distribution switchboard D, and the Blooming Mill motor and m-g set E. The Open Health d-c substation F is located in the center of furnace plant buildings some 1800 feet from the Blooming Mill motor room.

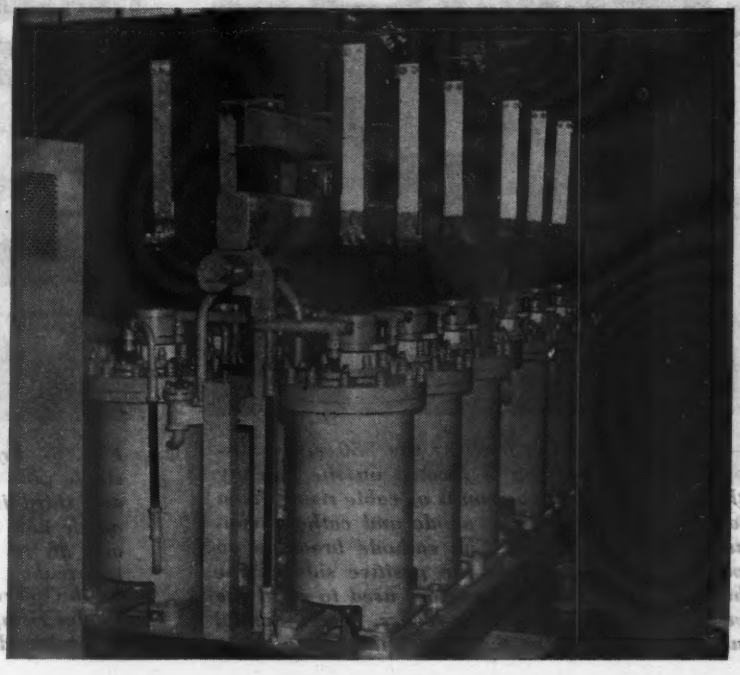


FIG. 4—Direct-current load center substation provides 250 v. d-c for both Blooming Mill and Plate Mill and is located in the Blooming Mill motor room (D in Fig. 2). The 12 tank unit is rated at 1000 kw. and operates in parallel with an identical unit in the Open Hearth plant. A 1000 kw. generator is also connected into the rectifier tie-bus providing a total of 3000 kw., 250 v. d-c power all inter-connected in parallel. The rectifier transformer tank can be seen in the background. The busbar rising from each tank is the anode (+) connection which runs directly through the transformer windings, through the anode breaker and onto the negative switchboard bus. The cathode connections (not shown in photo) rise from the tanks, go through the cathode breaker and are then connected onto the positive switchboard bus.

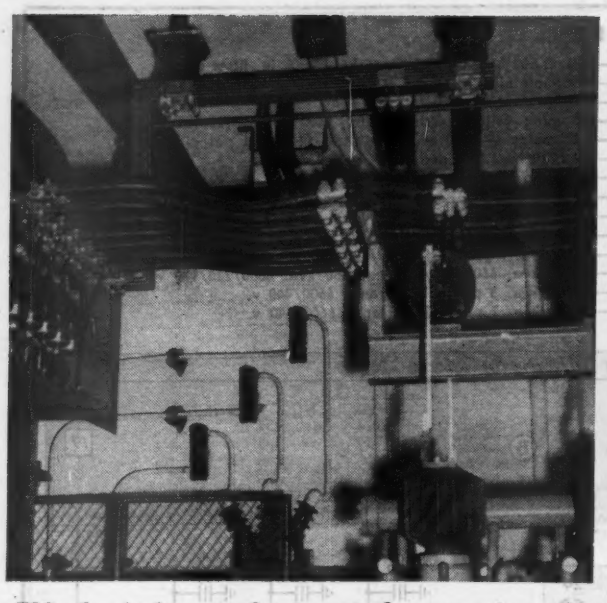


FIG. 5—A close-up showing anode connections. Note the I-beam which runs down the center above the rectifier tanks. The I-beam provides a mounting for the six current transformers, and in addition carries the weight of the cables which collect the anode current. One current transformer serves two rectifier tanks. The bus rises from the anode connection, passes through the C.T., then turns up and connects onto the proper cable. The twelve cables each connect to a different tap in the rectifier transformer winding to give equal phase spacing which in turn provides a smoother d-c output. Cables at top of photo rising through ceiling are anode and cathode connections to switchboard on balcony.

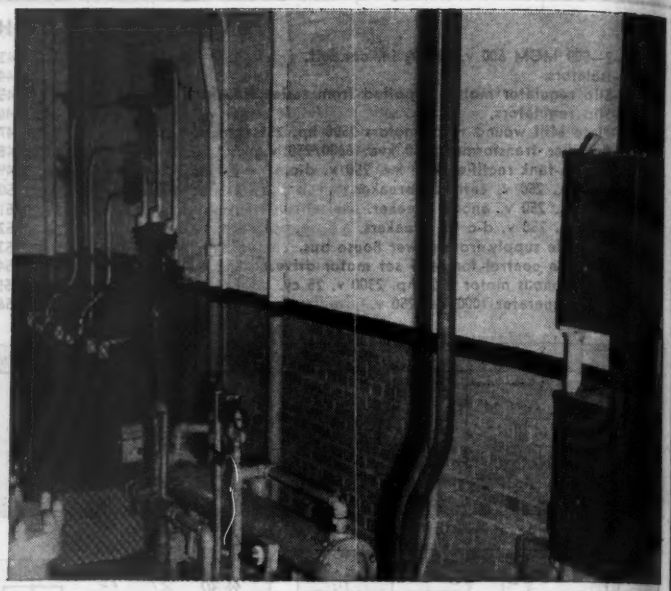


FIG. 6—Power for rectifier auxiliaries is provided by these two banks of transformers shown in Fig. 2 as 24 and 26. An automatic throw-over panel (25 in Fig. 2) cannot be seen in the photo, but is used to connect the rectifier auxiliaries to the one source in the event of failure of the other. The air-cooled bank on the right are 5 kva. and supplied from the Blooming Mill 440 volt board which is in turn fed from No. 10 breaker (see Fig. 2). Normal supply, however, is obtained from the bank of 10 kva. tubs on the left which are 6900/220 v. and feed directly from the No. 15 breaker of the 6900 v. switchgear as seen in Fig. 2. This provides considerable protection against rectifier auxiliary outage.

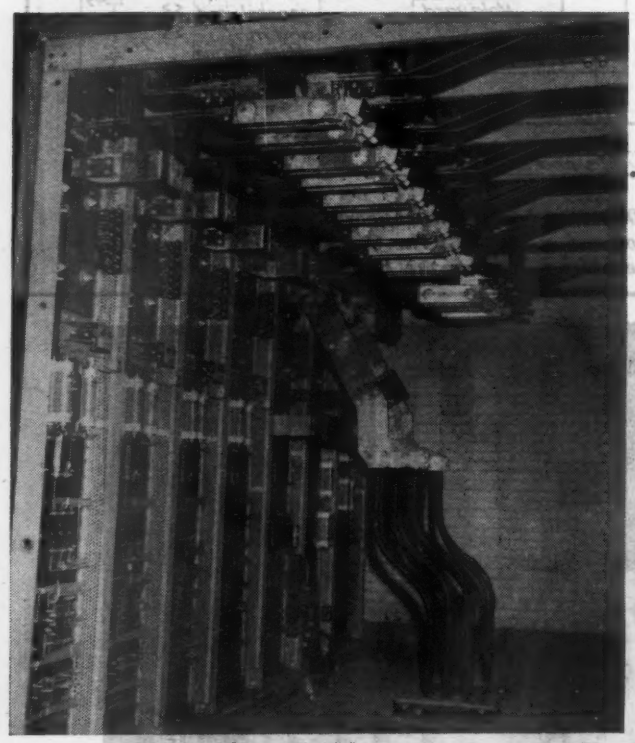


FIG. 7—A close-up of the back of the 250 v. d-c distribution switchboard which is located on the balcony above the rectifier. The two groups of cable rising from the floor on the right are the anode and cathode connections from the rectifier. The cathode breakers on the front of the board break the positive side of the line while the manual disconnects are used to open the negative side of each out-going d-c feeder. These manual disconnects can be seen at the top of the photo.

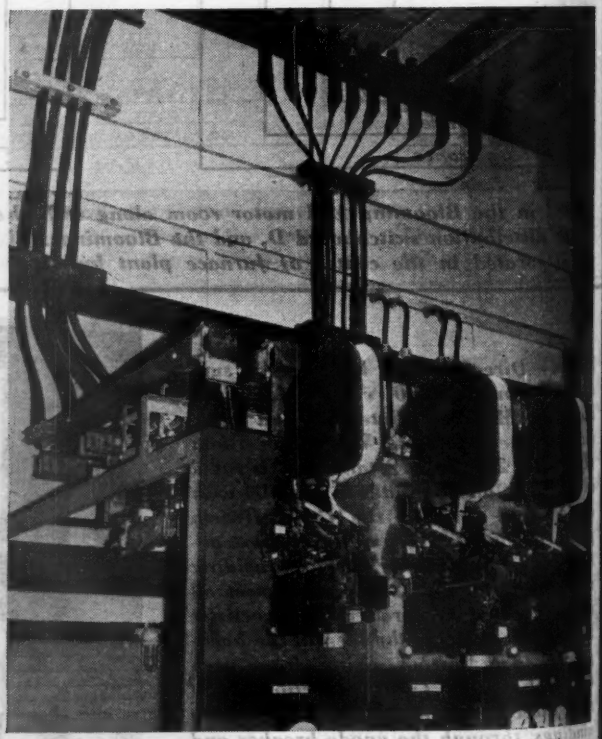


FIG. 8—Front of the d-c distribution board shows the single pole breakers. The two larger breakers (second and third from left) are 6000 A. and are the rectifier anode and cathode breakers respectively (shown as 37 and 36 in Fig. 2). The first breaker is the 4000 A. tie-breaker (38 in Fig. 2). The other four breakers on the board are for the various d-c distribution circuits. Cables rising on left are tie-circuits to Open Hearth and in center, distribution feeder circuits.

FIG. 9—One of 2500 hp. Plate Mill motors and fly wheel. The motor operates at 251 rpm. and is supplied power at 6.6 kv. Adequate ventilation is provided by the duct system and enclosures seen in the photo. As shown in the diagram of Fig. 2 (31 and 32) a slip regulator is used to control the motor. The regulator is similar to that shown in Fig. 11.

FIG. 10—On the extreme right and left can be seen the isolators that have been installed in the 6900 volt circuits to the two Plate Mill motors. The Plate Mill 440 volt a-c panel is shown in the center flanked on either side by the fan starters which operate the motor ventilating systems. The two large units above the 440 v. panel contain the control for the slip regulators.

In order to provide insurance against failure of a main breaker or supply feeder, rectifier auxiliaries at both d-c substations are fed from two separate sources on the 6900 volt bus.

As shown in Fig. 2, the bank of three 10 kva. 6900/220 v. transformers (26) normally feed the rectifier auxiliaries through the automatic throw-over panel (25). In the event of the failure of this source the interlock panel will throw the auxilliary circuits over onto the three 5 kva. 440/220 v. transformers (24). It will be noted that the 30 kva. bank normally feeds from No. 15 breaker on the 6900 volt bus while the 15 kva. emergency bank feeds through the Blooming Mill 440 v. bus supplied from breaker No. 10. This same type of connection is also used in the Open Hearth d-c substation F in Fig. 2.

Dynamic braking of the two 2500 hp. Plate Mill motors and the 3000 hp. m-g set is affected through interlocked dynamic braking breakers. Each breaker is located in a separate cubicle in the bank of 6900 volt switchgear. When braking is called for by the operation, the a-c breaker first trips "off", followed by the d-c breaker

(*Continued on page* 192)

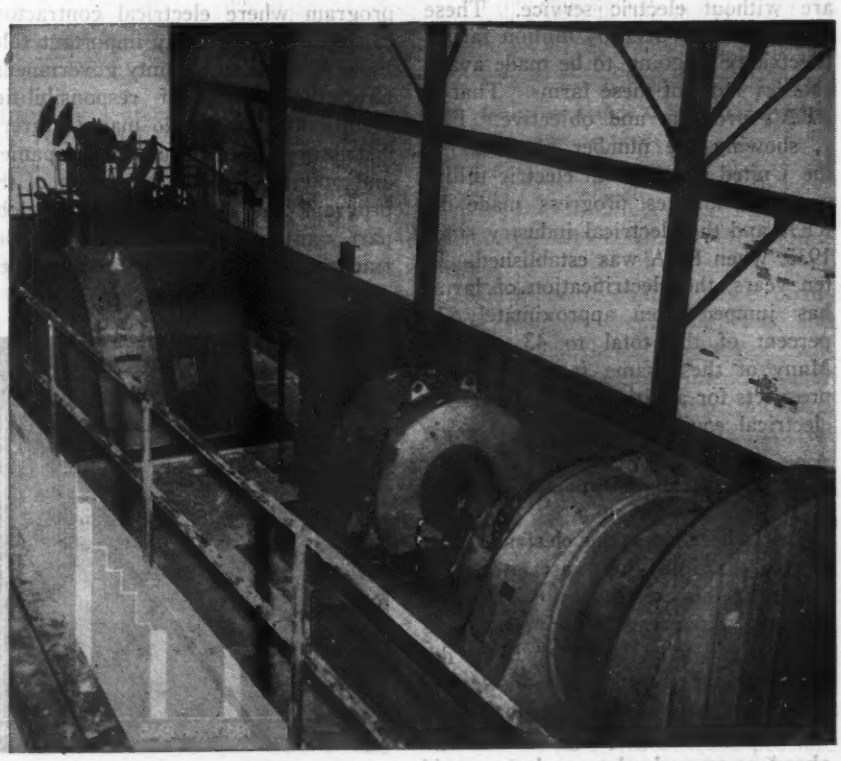


FIG. 11—Blooming Mill motor room as seen from the balcony. On the right can be seen part of the m-g set. The motor is rated at 3000 hp. 505 rpm. 6.6 kv. The two d-c generators are each rated 1500 kw. at 750 volts. On the left is the 3500 hp. reversing mill motor. Directly behind the mill motor is the slip regulator which controls the m-g set drive motor. Two similar units control the Plate Mill motors.

CONTRACTORS AND

Opportunity, and *Challenge*, exists now in the electrification of America's 3,500,000 non-electrified farms.

V-E DAY is now history. Progress is being made in the war against Japan. Reconversion is now in the making.

One wiring market, of an estimated $750,000,000 value is now available. With it goes an estimated three billion dollar market for electrical appliances, machinery, and equipment. This market will probably be favored by Federal subsidies, and is now ready to buy.

The farm market *is not an idle dream.* It is a reality *now.* This vast market is created by the Rural Electrification Administration program plus the efforts of electric utilities to give the farmer the benefit of electrification. REA estimates that over six million rural dwelling units are without electric service. These are located on over 3½ million farms. Electricity is going to be made available for most of these farms. That is REA's program and objective. Fig. 1, showing the number of farms in the United States with electric utility service, indicates progress made by REA and the electrical industry since 1935, when REA was established. In ten years, the electrification of farms has jumped from approximately 11 percent of the total to 43 percent. Many of these same farms are now prospects for additional wiring and for electrical equipment.

Contractors' Opportunity

Just where does the electrical contractor fit into this vast program? What is his responsibility, and to whom? How can he approach this market, and what benefits will he derive from it? Frankly, the answers to these questions are largely up to the contractors. The program will go ahead, at an early date, and at a rapid pace.

Stated briefly, it is believed that the contractor can find the answer to these questions if he will do the following things:

1. Contact the Rural Electrification Division manager of the local electrical utility company, determine how his company plans to promote this program, and how the electrical contractor may cooperate.
2. Check the wholesalers for definite plans he has made, or is making, actively promoting rural electrification.
3. Talk to the local County Agent, or Home Demonstration Agent, to determine how the contractor can cooperate in his program.
4. Contact the Extension Service, Agricultural Education Service of the State Agricultural College, to determine how the State plans to promote rural electrification.

Rural electrification is logically a program where electrical contractors can assume a critically important role. Federal, state and county governments have their share of responsibilities in this program, as do manufacturers, distributors, electric utility companies, and others. But the execution of the program, the actual "doing the job" part, must be carried out by the contractors, and an active, enthusiastic constructive approach to this problem by the contractors must be supported by the wholehearted cooperation of all other interested groups.

Some of the more important aspects of rural electrification are presented here as a background for contractors who want to make the most of this market.

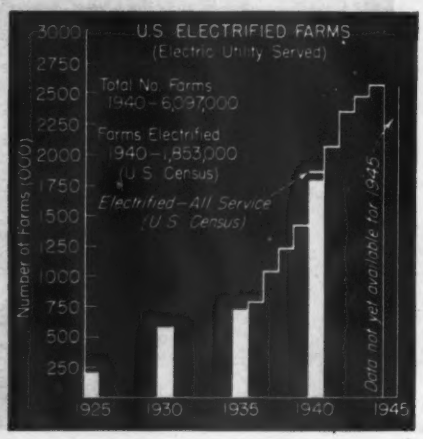


FIG. 1—Growth of electric utility served farms has increased at rapid rate since 1935. Approximately 42 percent of total number of farms were electrified as of Jan. 1, 1944. (Data from Edison Electric Institute)

Importance of Rural Electrification

Electricity will help provide a decent standard of living for the farm home. The RE program is geared to provide broad electrical service. It will make farm life more pleasant. It will make possible the use of many modern conveniences which eliminate hard labor, save time, provide added comforts and increase the well-being of the farm family. It will create a real desire in the hearts of many rural young men and women to stay on the farm, rather than to migrate to the city where these modern conveniences are part of every day living.

Rural electrification will encourage the development of rural industries. It is also basic to the effective use of rural schools, churches and community centers, to the establishment of community health clinics, service enterprises, entertainment and recreational facilities. It will also provide a key to the development and utilization of natural resources in rural areas.

The effective application of electricity to farm production is in its infancy. Farmers are just now beginning to realize that "electro-agriculture" is an open door to farming as a successful business. Production and conservation of crops and livestock depend more and more on electrical aids.

Scope of Program

The scope of the rural electrification program is so broad that it involves many branches of industry. Successfully developed, it will benefit not only

RURAL ELECTRIFICATION

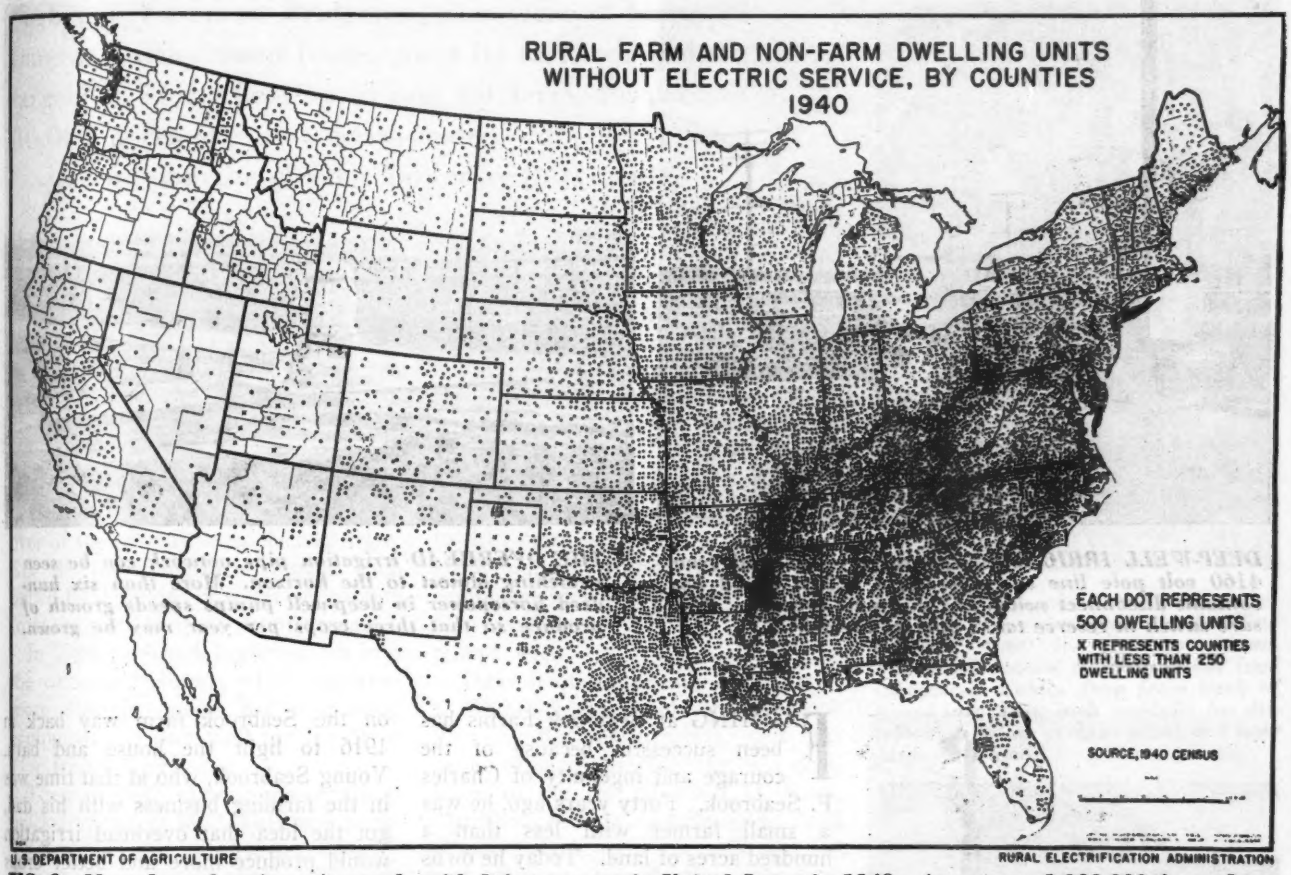


FIG. 2—Map shows location of non-electrified farm areas in United States in 1940. An estimated 900,000 farms have since been electrified. Approximately 3,500,000 farms are still without electric service.

the rural population, but the nation as a whole.

High tension transmission lines must be constructed to serve approximately five million rural dwellings beyond the reach of present urban power systems. These lines will be constructed by electric utilities, or by electric cooperatives under Federal financing through REA. This job must, and will, be done first.

Lines must be constructed from transmission lines to farm buildings and dwellings. Buildings and dwellings must be wired. Careful analysis of farmers' requirements must be made to insure adequacy of service. This is the most important phase of the entire rural electrification program from the contractors' standpoint. Not only must the contractor make full use of his knowledge of electrical circuits and wiring methods but he must also develop a knowledge of farm uses of electricity, if he is to intelligently advise the farmer on location of outlets, type of service, switch locations and arrangements, etc. Many electric utilities have already planned extensive training programs, which will be made available to their own Rural Electrification Division personnel, to contractors, and to electrical farm educational groups. Manufacturers of electrical equipment have educational programs and literature in preparation, to assist in this phase of training. Farm publications, State Agricultural colleges and REA are already actively engaged in the dissemination of knowledge on the application of electricity on the farm.

Need for Immediate Action

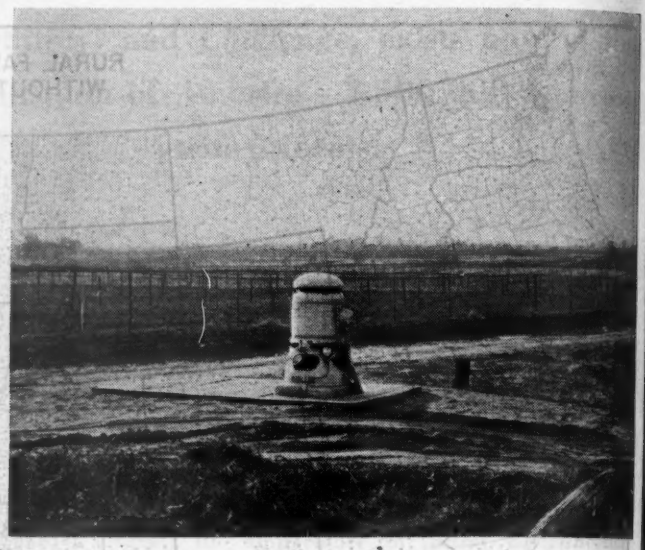
The American farmer faces a real problem. He is being called upon to produce food, not only to meet our own requirements for civilian and military use, but also to feed many millions of people in devastated Europe. Farm labor is at a premium. Labor saving devices and machinery for farm use can do much to help relieve this situation.

The expansion of the rural electrification program beginning now and carrying on through postwar, will stimulate postwar employment. Labor will be required to produce the wire, transformers, motors, wiring material and devices, and farm machinery. Labor will also be required to construct the transmission lines and to install the wiring and equipment. Farming efficiency will be improved, enabling the farmer to better meet his problem of producing food in sufficient quantities to feed the additional millions of people. Unused land areas can be improved through irrigation, and alternative uses of land will be made possible through the uses of electricity.

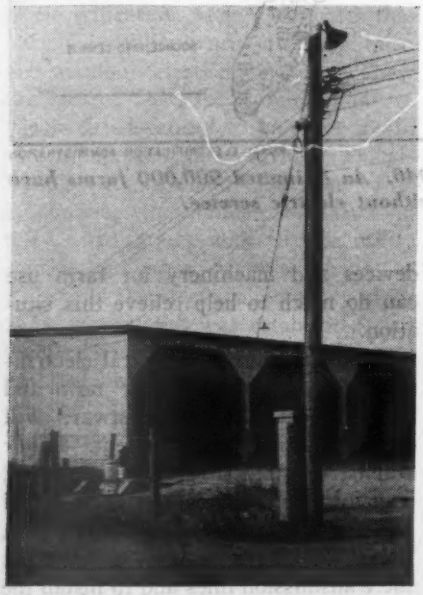
The farmer, the electrical industry, labor, and the Nation, all stand to benefit from an immediate and aggressive concerted, cooperative effort to electrify rural America.

Electricity

DEEP-WELL IRRIGATION pumps are supplied from 4160 volt pole line and operate at 220 v. Wood box contains disconnect switch and magnetic breaker. Pressure switch in reserve tanks operate breaker.



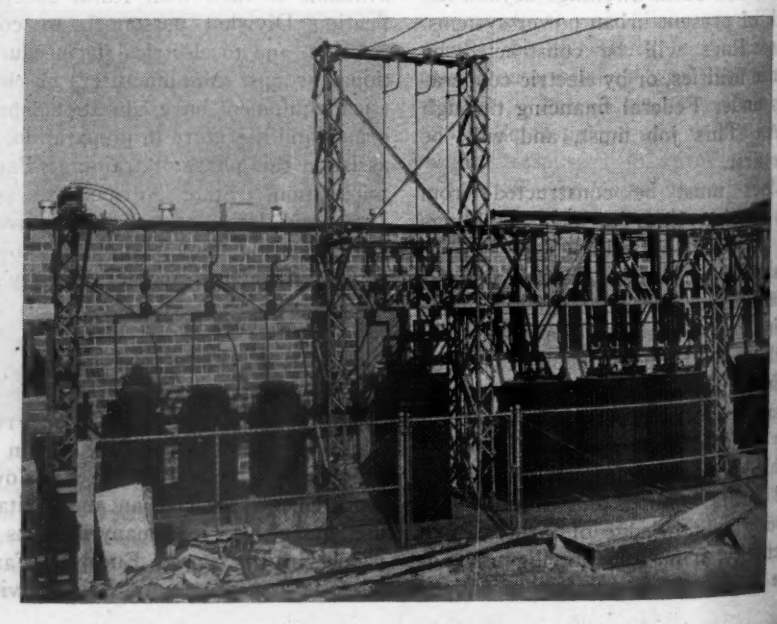
THE OVERHEAD irrigation pipe network can be seen stretching almost to the horizon. More than six hundred horsepower in deep-well pumps speeds growth of produce so that three crops per year may be grown.



FARM BUILDINGS are supplied 110/220 v. for miscellaneous power and lights. Note floods atop pole and shed for yard lighting. Pole also carries 220 v. three phase for deep-well pump in lower left center of photo.

PACKING PLANT substation was designed by and installed under the direct supervision of C. James Cox, electrical engineer for Seabrook since 1919. Now Plant Engineer Jim Cox has engineered the farm electrification from the very beginning. Atlantic City Electric Company supplies this customer-owned substation at 4 kw. from their own 33 kv. station.

FARMING at Seabrook Farms has been successful because of the courage and ingenuity of Charles F. Seabrook. Forty years ago, he was a small farmer with less than a hundred acres of land. Today he owns a multi-million-dollar truck farming and packing business. And no small part of this success can be attributed to his adoption of modern technology including complete electrification of the entire farm. Electricity made its debut on the Seabrook farm way back in 1916 to light the house and barn. Young Seabrook, who at that time was in the farming business with his dad, got the idea that overhead irrigation would produce more and better crops and shortly thereafter installed a half-dozen gasoline driven centrifugal pumps. Water was pumped from a pond into the irrigation piping system. Then in 1924, his electrification program began in earnest.



Grows Farms—AND BIG

Seabrook Farms at Bridgeton, New Jersey, home of famous quick-frozen foods, owes its meteoric growth largely to electrification. From 60 acres, its present 30,000 acres are now criss-crossed with 4 kv. lines supplying the electric power requirements.

The farm was growing. More acreage had been bought. More irrigation water was needed, and more produce had to be shipped to market. A modern sawmill was built and equipped with direct-driven motors to make crates. The mill connected load totalled 200 hp. in 5 to 30 hp. individual drives.

The irrigation system was changed over at the same time to electric drive. Six 35 hp. centrifugal pumps each pulled 1000 gallons of water per minute from the pond to spray thirsty crops.

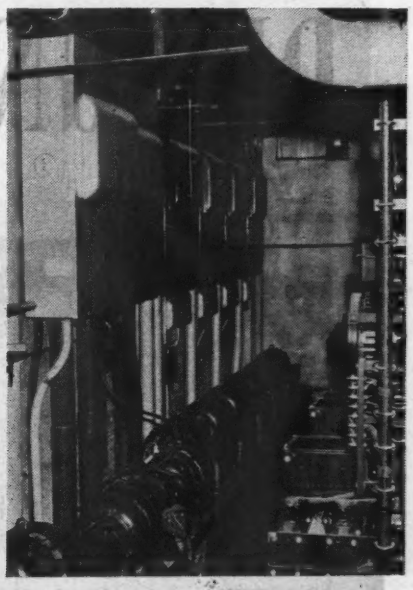
In 1934, Seabrook branched out into the canning business, which required more electric power for processing equipment and deep-well turbine drive (for fresh water).

Then in 1937 came commercialized quick-freezing of food. This new packing process had much greater capacity than the farms could supply. So more acreage was obtained and a new huge irrigation system constructed. The power growth from that time has been phenomenal, with application of electrical equipment to the actual farm operations as well as to such packing plant motor drives as described below.

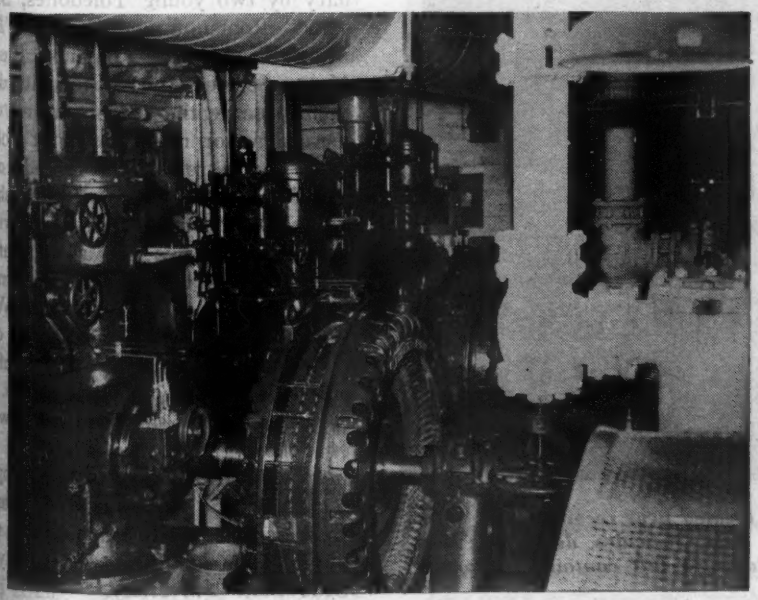
At present irrigation pumps total some 680 horsepower. Another 600 hp. in deep well pumps supply processing water to the packing plant. Five-hundred horse power is used in a new dehydration plant (strictly a "war baby"), and 2000 hp. in compressor motors for refrigeration. In addition to this, there is now some 6000 hp. in small motors driving packing plant equipment such as conveyors, fans and blowers, air conditioning equipment, pumps, etc.

There is of course only one Charles F. Seabrook. And only one Seabrook Farms. But nevertheless, this example of successful farming is a challenge to the rest of rural U. S. A. Furthermore it is a challenge to *John Watts,* electrical contractor, to go out and sell farm electrification. Successful farming depends greatly on electricity; and the greater the success, the more electrical equipment will be needed. And the utilization of electric power means wiring systems and good business for the contractor.

***CLOSE-UP** of only part of the power and lighting switchboard in building adjacent 4000 volt outdoor station. Panels are added as distribution load increases. Cables drop from back of board into three inch conduits for distribution to the various plant and near farm-yard load.*



***CONTROL BOARD** for six of the 175 hp. synchronous compressors is seen at right. On left, mounted on wall, are the 220 volt disconnect switches for each. Beneath each disconnect is the motor-generator exciter for its respective synchronous motor.*



***ONE OF THE TEN 175 hp. compressors** used to refrigerate and quick-freeze fresh produce at the rate of one and a quarter million pounds per 24 hours. Average time from vine to frozen state is two hours. (Left)*

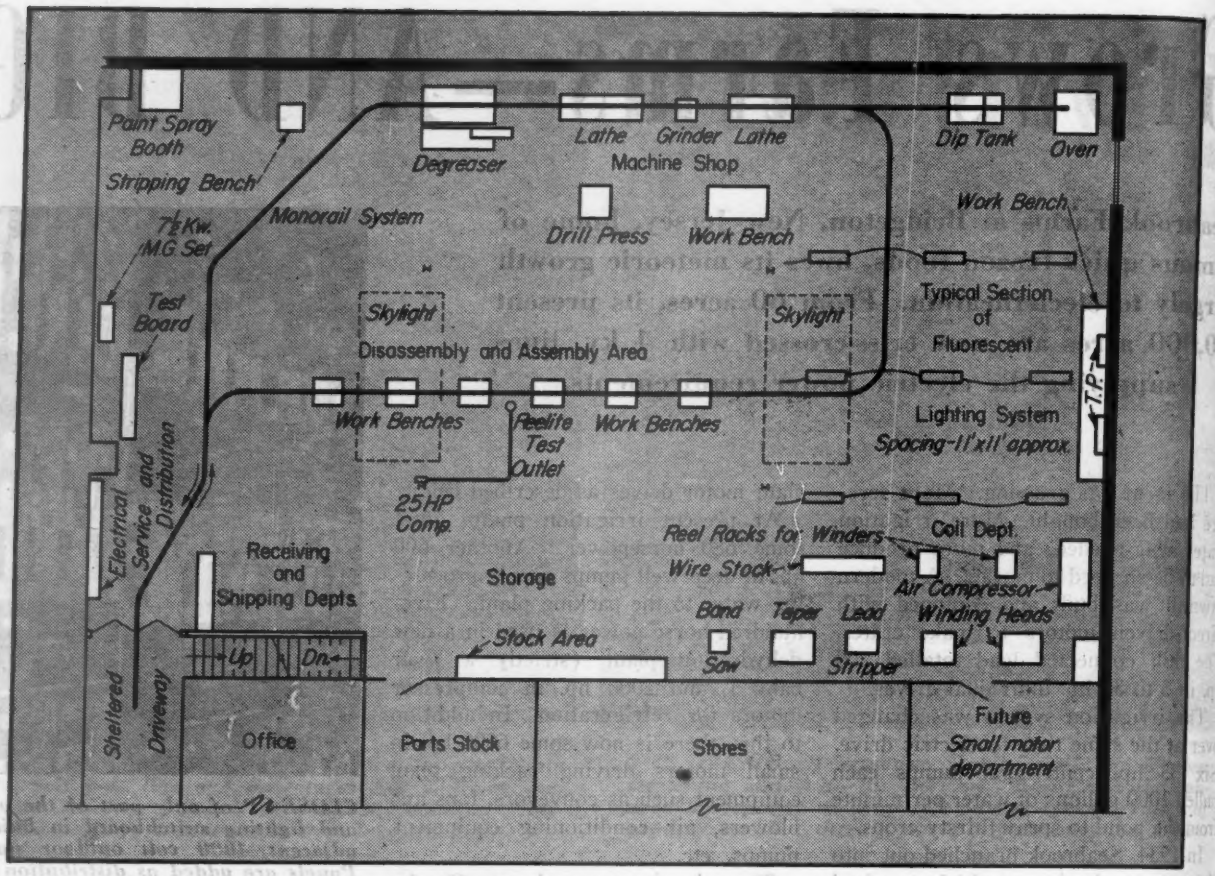


FIG. 1—Shop layout features "free work flow" with various repair departments built around the center disassembly and assembly line. Mono-rail system loops heavy repair areas.

DESIGNED for SERVICE

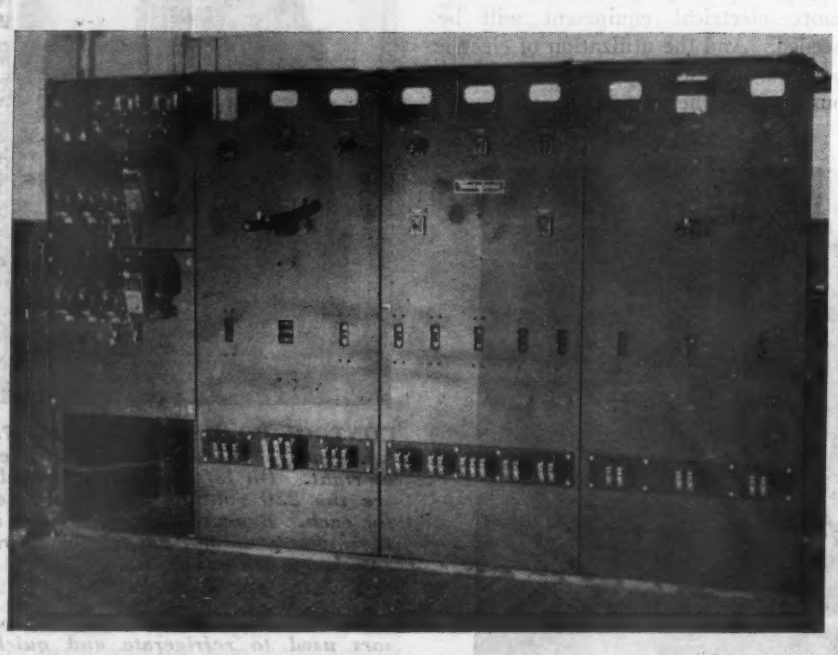


FIG. 2—Modern test board, conveniently located near receiving and shipping departments as well as assembly line, provides dead-front test facilities for a-c and d-c equipment. Panel at left contains contactors for reduced and full voltage operation.

THE dream of every young man—to start in business for himself with brand new equipment and an efficient layout—was realized early in January by two young Toledoites, S. M. "Bud" Romanoff and William "Red" Morgan, when the Romanoff Electric Motor Service, Inc., opened its doors to help serve the industrial and commercial motor repair needs of Toledo, Ohio and to relieve the already overtaxed condition of existing shops. Unlike most shops which start with a workbench or two and a minimum of equipment, this one took full form on paper before a wheel was turned. When they opened, they were able to offer their customers the advantages of the most modern equipment facilities.

Designing the shop was not a week-end chore. Both Bud and Bill, who met while working in the shop of Price Electric Company in Columbus, were accustomed to burning the midnight oil during their student days at Ohio State University.

Toledo's newest motor shop is designed along modern industrial production lines. Layout features free work flow, modern equipment and ample work space with a view toward future expansion.

By August Eckel

After deciding to open a shop, they spent many nights together toying with layouts, selecting equipment and adapting ideas gleaned from shop visits to fit their own specifications (they already had chosen the building which was to house the shop). They knew what was needed—a layout that closely paralleled modern industrial production methods; one that reduced to a minimum heavy equipment handling; departmentalized design with a center assembly area; modern equipment for efficient operation; adequate and safe test facilities; plenty of working area and sufficient space for future expansion. The result of their labors is shown in Fig. 1.—the shop layout as it is today.

Based on the principle of "free work flow" the complete shop design is built around the disassembly and assembly area as the nucleus. From this point, in the center of the 100 ft. by 60 ft. shop, the motor parts (some in tote boxes) fan out to the various departments where the required repairs are made. When completed, the parts from the stripping, cleaning, machine shop, coil winding, dipping and baking departments converge at the assembly bench. From here the assembled motor goes direct to the test board, then to the paint spray booth and finally to the shipping department to await delivery or pick-up.

Spotting Equipment

Considerable study was devoted to spotting shop equipment. Of prime importance was the proper location of the various departments to save steps and reduce back-tracking to an abso-

FIG. 3—General view of shop area showing machine shop on left, disassembly and assembly benches in center. Note Reelhouse (retractile compressed air hose) over benches near mono-rail. Reelite test outlet is directly behind it.

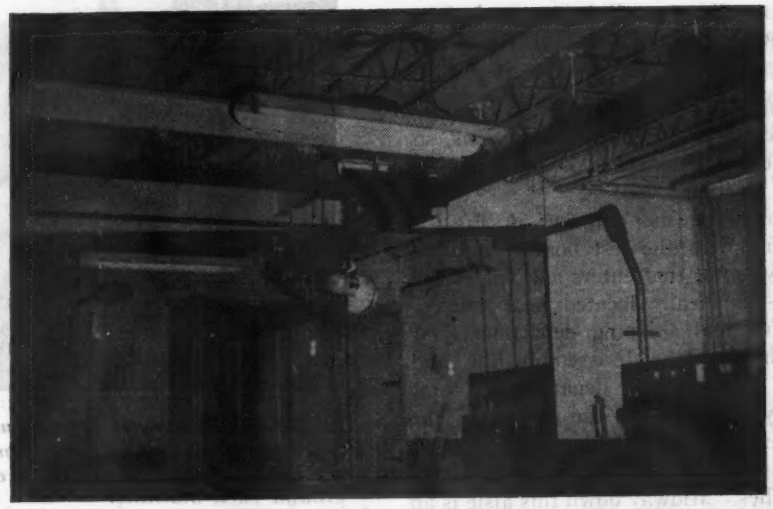


FIG. 4—Mono-rail system starts at entrance driveway, then loops shop area. Note test board at right.

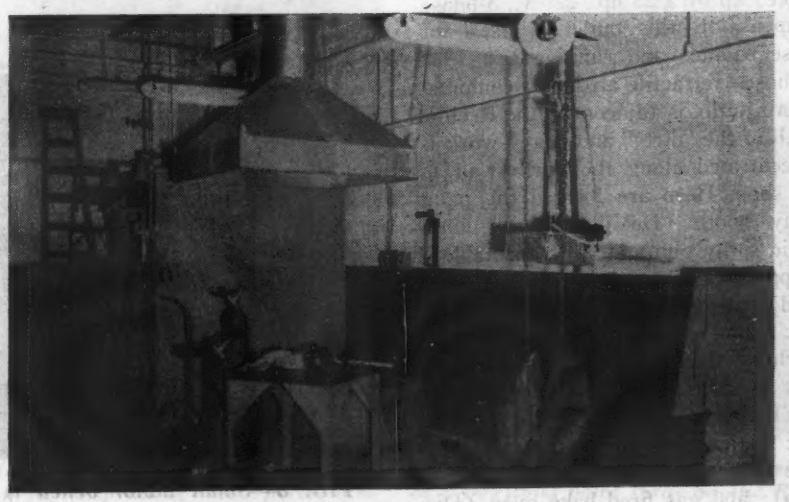


FIG. 5—Stripping dept. is located adjacent to cleaning tank and within easy reach of disassembly benches. Hood over bench contains exhaust fan.

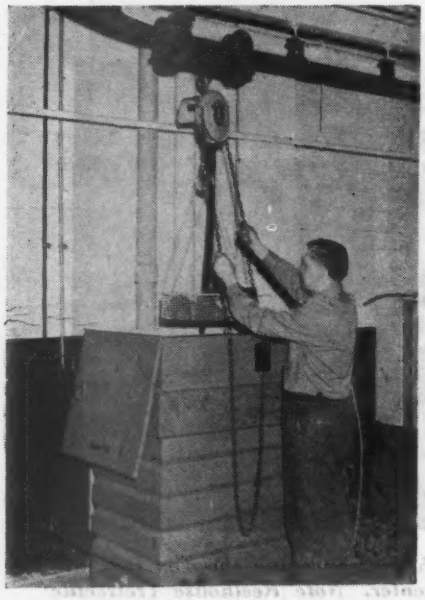


FIG. 6—Degreasing unit using trichlorethylene solvent speeds up cleaning process. Bill Morgan demonstrates handy wire basket for immersing small parts. Hoist is attached to mono-rail system.

lute minimum. A man can work more efficiently in uncrowded conditions, so ample working space was allotted to each machine.

Following the diagram in Fig. 1, we find that the test board—used on every motor that enters and leaves the shop—is ideally located near the receiving and shipping departments, at the head of the disassembly line and near the finishing department (paint spray booth). In the center of the large room and directly under the skylights are the disassembly and assembly benches. Midway down this aisle is an overhead spot test outlet consisting of a heavy-duty Reelite with 35 feet of 3-conductor, No. 6 cable as test lead. Backed up by a 25 hp., 220 v., 3-phase compensator, this outlet is used for phase balance and running tests. A reelhose (retractile air hose) compressed air outlet is adjacent to the Reelite.

All of the "dirty" and heavy work is concentrated along the north wall of the shop. Here are located the paint spray booth (DeVilbiss—with automatic spray gun and work turntable); stripping bench and hood (gas torch used); degreaser for cleaning (Rex unit using trichlorethylene solvent); machine shop (two lathes, a double-post grinder, drill press and work bench); dip tank (5-ft. by 3-ft. by 3-ft. unit sectionalized for stator and armature dipping— total capacity, 275 gallons); and gas fired bake oven (Dispatch unit No. RS3—automatic heat control).

The coil department along the south wall of the shop, includes two winding machines (Potter-Rayfield) with heads having an integral attachment to form coils (eliminates need of coil spreader for type of work done); a wire lead stripper; taping machine; band saw; and magnet wire reel racks. The remainder of the south wall and floor area is allotted to storage.

A long work bench with two test panels along the east wall of the shop is now being used for small motor repair work. In the future, when equipment and manpower are again available, the small motor department will be expanded as a separate unit located in one of the vacant stores (see Fig. 1) in front of the shop area. Bud's post-war plans include a well organized stoker and refrigeration motor service.

Considerable thought was given to the design of the main test board. Romanoff and Morgan wanted one that would give a reasonable amount of flexibility; one that was dead-front to assure maximum safety; one that was simple to operate. They submitted their ideas to the Westinghouse Electric & Mfg. Co., and came up with the custom-built board illustrated in Fig. 2—one of the most modern test boards to be found in a motor service shop. With the exception of one section containing two sets of contactors (push-button controlled) for full voltage and reduced voltage operation, the entire steel panelled board is of dead-front construction.

The first section immediately adjoining the contactor panel provides test facilities for 60, 100, and 225 amp.,

FIG. 7—Coil dept. is located near one corner of the shop adjacent to the assembly benches. One winding machine is still "on order." Wire reel racks are directly in front of machines. Note ample working space around each machine.

FIG. 8—Small motor bench is at one end of the shop, out of the normal flow of large motor repairs. Note test panels on wall and bench type drill press. When conditions permit, this department will be expanded and moved into a vacant store area adjacent to the coil department.

MAJOR EQUIPMENT ITEMS

Stripping Dept.

1—Stripping bench
1—Exhaust hood ventilator
1—Acetylene torch
1—Gas torch
1—Scrap wire bin

Cleaning Dept.

1—Rex degreaser and accessories

Machine Shop

1—16-in. lathe
1—Small lathe
1—Dual post grinder
1—Drill press
1—Small shear
1—Arbor press
1—Work bench with electrical outlets

Coil Dept.

2—Winding machines—heads have attachments to form coil ends
1—Wire lead stripper
1—Taping machine
1—Band saw
1—Insulation cutter
2—Magnet wire stands for winding machines
3—Magnet wire storage racks

Testing Facilities

1—Main test board, 4-section dead-front type with reduced and full voltage contactor panel, provides a-c and d-c test facilities
1—Spot test outlet in assembly dept. —overhead Reelite controlled by a 25 hp. 230-v., 3-phase compensator
1—Portable high voltage test set
1—Balancing ways

Small Motor Dept.

Large work bench with two test panels, small drill press and necessary tools and accessories

Finishing Dept.

1—DeVilbiss paint spray booth with automatic spray gun and work turntable

Dipping Dept.

1—Dip tank—5-ft. by 3-ft. by 3-ft. double section—total capacity, 275 gal.
1—Despatch RS3 gas fired bake oven, automatic heat control
1—One-ton electric hoist

Equipment Handling

1 3500-pound capacity mono-rail system looping shop
2—One-ton chain hoists

Miscellaneous

Normal complement of small tools and accessories

3-phase, 220/440 volt loads. The three flush meters at the top (one 100 amp. and one 225 amp. ammeter, one 600 volt voltmeter) are equipped with phase selector switches. The panel can be energized with either 220 or 440 volts through a master selector switch. Flush mounted circuit breakers of proper rating protect three sets of new spring-tension type test jacks at the bottom of the panel. Test-lead plugs are inserted in the bottom of the jacks.

The second panel has similar equipment for testing 25 and 60 amp., 110 v. and 220 v. single-phase loads and 25 amp., 3-phase, 220 or 440 v. loads. The third panel, of similar construction, provides test facilities for 25, 60, and 100 amp., 115 or 230 v. direct current loads. The a-c panels are fed by a 150 kva., 3-phase, air-cooled, autotransformers connected open delta; the d-c panel by a 7½ kva. motor generator set.

Equipment Handling

A frequent obstacle to efficient motor service shop operation is the lack of proper methods of handling heavy equipment. Crowded shop conditions often preclude the installation of monorail or other systems to eliminate the back-breaking chore of hustling equipment from one department to another. Romanoff had this in mind when he laid out a roomy shop and installed a 3500 pound capacity mono-rail system.

The mono-rail starts at the delivery entrance (See Fig. 1) passes in front of the test board, then loops the shop going down over the line of disassembly and assembly benches and returning over the machine shop, cleaning and stripping departments. A spur extends beyond the loop to serve the dip tank and bake oven. Several one-

[Continued on Page 129]

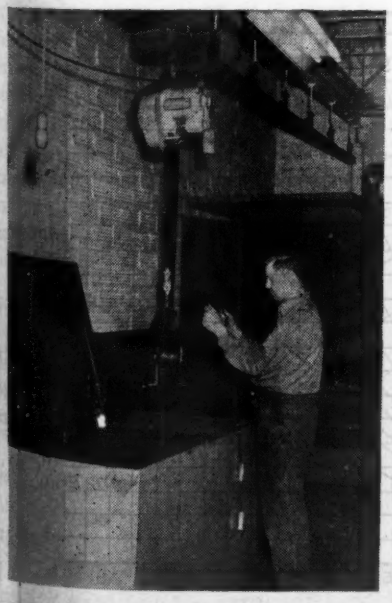


FIG. 9—Electric hoist simplifies dipping chore. Note sectionalized tank—one side for large equipment, other for small motors.

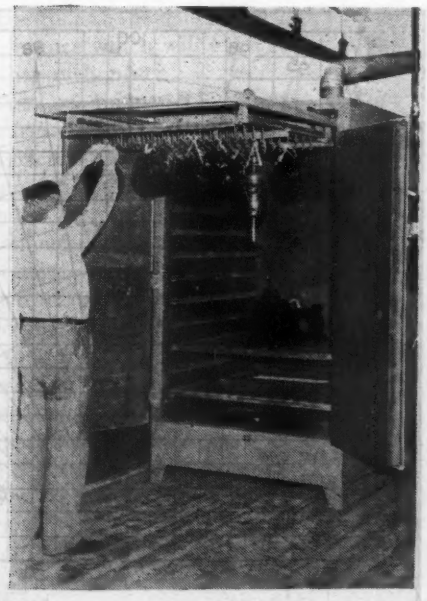


FIG. 10—Bake oven has a pull-out rack for suspending small parts; also slide-out grilles for heavier equipment. Unit is a Despatch RS3 gas fired oven.

FIG. 11—Finishing dept. consists of a DeVilbiss paint spray booth. Bud Romanoff demonstrates work turntable and automatic spray gun.

AUTOMATIC SWITCHING of Capacitors

Step-by-step procedure for calculating capacitor values for application in voltage and power factor correction and in reducing losses and kva. demand.

By W. H. Cuttino

Circuit Breaker and Protective Devices Engineer, Westinghouse Electric Corporation

CAPACITORS are usually installed in industrial plants to reduce the magnitude of lagging magnetizing current supplied from the distribution circuit. This magnetizing current can be eliminated by adding capacitors which will reduce the kva. demand, boost the voltage, reduce losses and improve power factor. The reduction in demand releases capacity for other purposes which is quite important at any time when an industrial plant is being expanded to meet the needs of increased production requirements economically with existing facilities. In fact, in some cases, power requirements can be fully met with existing facilities only after capacitors are installed to reduce the demand.

The effectiveness of shunt capacitors can often be increased by switching them "on" and "off" the circuit in accordance with load duty cycles. This is particularly true on fully loaded circuits with rather widely varying load characteristics. Capacitors with switching equipment are desirable in order to maintain improved voltage conditions at the load during all load conditions and to hold the feeder currents and reactive kva. to a minimum. There are three generally accepted methods of initiating the switching of capacitors automatically:

a. In response to circuit voltage by means of a voltage actuated relay for regulating that voltage within desirable limits by switching capacitors. See Fig. 2. This scheme is adaptable to either single or multiple step control.

b. In response to reactive kva. load by means of a phase angle relay connected for regulating the reactive kva. within desirable limits by switching capacitors. See Fig. 3. This scheme is adaptable to either single or multiple step control.

c. In response to load by means of a current actuated relay to switch the capacitor "on" and "off" the circuit at sustained pre-determined values of load current. See Fig. 4. This scheme is adaptable to single step control only; however, several separate equipments may be used, each adjusted for different values of load current to obtain the same effect as multiple step control.

The decision as to whether or not the capacitors should be switched automatically depends on the purpose of the installation, on the size of the capacitor bank, on the extent to which kw. and reactive kva. loads vary throughout the day and on the variation of voltage with load. The first step is usually to make measurements of reactive kva., kw. and voltage over a typical load period to determine the capacitor kva. requirements, and the type of control if it is found desirable to switch the capacitors automatically. If it is necessary to vary corrective kva. in order to improve the voltage condition, consid-

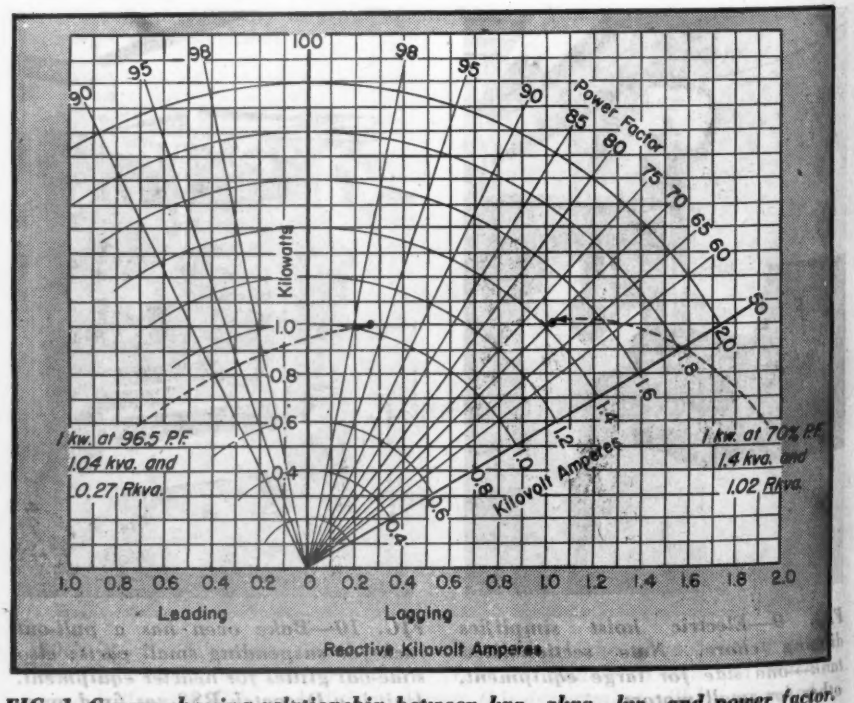


FIG. 1. Curves showing relationship between kva., rkva., kw., and power factor.

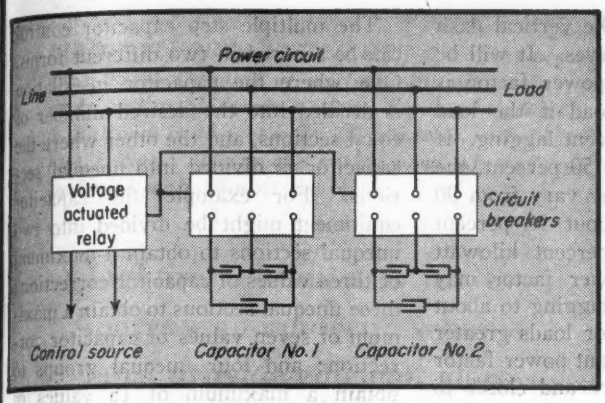


FIG. 2 Multi-step voltage-actuated automatic switching of capacitors. Capacitors should be switched in relation to circuit voltage to keep that voltage within satisfactory limits on an unregulated bus when objectionable overvoltages are encountered during light load periods.

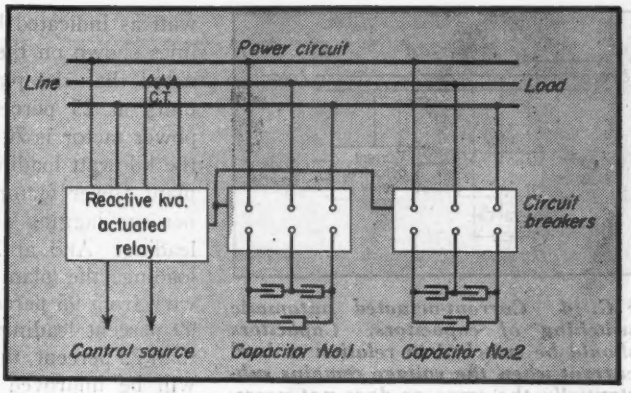


FIG. 3 Multi-step reactive kva.-actuated automatic switching of capacitors. Capacitors should be switched in relation to reactive kva. load when the voltage remains substantially the same or does not necessarily vary with plant load; or when load pf. varies with kw. load.

eration should be given to the possibility of splitting up the capacitor, and placing some units at motor terminals for individual motor correction. Then they could be cut in and out with the motor without additional switching equipment.

The voltage rise produced by the capacitor at the point of installation is the sum of the voltage rise in the primary power feeder from the substation to the primary of the plant transformer, plus the rise in the transformer, plus the rise in the secondary feeder from the transformer to the capacitor. When regulated voltage is supplied, the voltage rise should be determined from the regulated point on the circuit to the capacitor location when considering switching capacitors in relation to line voltage.

When voltage regulation is of primary importance and it is found that the voltage is objectionably high during light load periods with the total proposed capacitor kva. connected, the following steps are suggested in determining the number and size of capacitors to be switched and what size capacitor may be left permanently connected.

1. Determine light load voltage with proposed capacitor connected.

2. Determine maximum capacitor kva. that can be connected during light load conditions and stay within permissible voltage limit.

3. Determine maximum size capacitor unit that can be switched in one step and stay within satisfactory voltage limits.

4. The difference between the total capacitor kva. and the capacitor kva. permissible during light load conditions will be the capacitor kva. to be automatically switched.

5. The ratio of the total capacitor kva. to be switched to the maximum size capacitor to be switched in one step determines the minimum number of switching steps required to stay within satisfactory voltage conditions.

For example, consider the case of a load out on a long feeder where objectionable voltage drop occurs between the regulated bus and the point where the load is connected. Sufficient capacitor correction is installed to raise the voltage at the load to a desirable value during full load but it is then found that the light load voltage is 10 percent high; whereas it is desired to keep the voltage within plus or minus 2½ percent of normal (total variation 5 percent). In order to keep the voltage within plus or minus 2½ percent of normal, the size of the capacitor steps should be selected to give a voltage change less than 5 percent by a margin or tolerance which will prevent the possibility of hunting. If we decide to use plus or minus 0.5 percent voltage margin to prevent hunting, then the capacitor step should change the voltage 5 percent. The best arrangement in this case appears to be a permanently connected capacitor that will give a voltage rise of about 2 percent, and two capacitor steps each to give a voltage change of 4 percent. The first capacitor step will be switched "on" and "off" at approximately 33 percent load, and the second "on" and "off" at approximately 66 percent load to keep the voltage within satisfactory limits. See Fig. 5. Of course, actually the capacitor will be switched "on" at somewhat higher loads than 33 percent and 66 percent, and will be switched "off" at loads slightly less than 66 percent and 33 percent load in order to provide sufficient margin to prevent hunting. The decision in this case will no doubt be to switch the capacitors automatically in relation to circuit voltage at the load. Once the relationship is known between load voltage variation and variation in load, the desired voltage rise at full load, the maximum permissible voltage change, and the voltage rise for a particular capacitor rating are established. Then it is easy to determine the size and number of capacitor steps to keep the load voltage within satisfactory limits.

To cite another case, let us suppose that sufficient capacitors are connected to a bus where the voltage is well regulated to correct for full load conditions. However, it is found desirable to switch the capacitors at light load conditions to avoid payment of penalties because of excessive leading power factor during light load periods. Or perhaps it is necessary to reduce the demand and losses to a minimum for various load conditions. Then the two other types of control operating on line current and reactive kva. should be considered.

If the load voltage remains substantially the same due to good regulation on the bus, and the load power factor remains practically constant with variation in kilowatt loading, then consideration should be given to switching the capacitors in relation to load current. See Fig. 4. So long as the load power factor remains substantially constant with variation in kilowatt load, the results obtained when switching the capacitor in relation to load current will give practically the same results as when switching the capacitors in relation to reactive kva. Both potential and current transformers are required for reactive kva. switching; only a C. T. is required for the current control scheme.

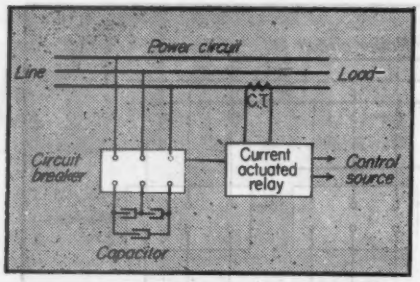


FIG. 4 Current-actuated automatic switching of capacitors. Capacitors should be switched in relation to load current when the voltage remains substantially the same or does not necessarily vary with load; or when the load power factor remains practically constant with variation in kilowatt loading. Switching will add or remove capacitors from the circuit to match the magnetizing rkva. of the load to improve the plant power factor, or reduce kva. demand and losses.

On the the other hand if the load voltage remains substantially constant and the power factor varies considerably with variation in kilowatt loading, then the capacitor should be switched in relation to reactive kva. Let's assume that it has been decided to add capacitors to correct the power factor at full load from 70 percent to approximately 96½ percent lagging to reduce the kva. demand to about 79 percent of its original value. The capacitors are to be divided into three equal sections, one to be permanently connected and two of which are to be switched in relation to reactive kva. to add or remove capacitors from the circuit to match the active kva. of the load. This, in turn will reduce the demand for different values of kw. loading.

By referring to the curve of Fig. 1, it will be noted that with a full load represented by 1 kilowatt, at 70 percent power factor the reactive kva. units are about 1.02 for each kilowatt of load. At approximately 96½ percent power factor the reactive kva. units are only about .27 for each kilowatt of load. Therefore, 0.75 kva. (1.02–0.27) of corrective capacity for each full load kilowatt is required to improve the power factor from 70 percent to about 96½ percent. If the capacitor is divided into three .25 kva. units for each full load kilowatt, and if one of the units is connected permanently to the circuit and the two other steps are to be switched automatically, then it is suggested that consideration be given to having the control adjusted to switch capacitors "on" when the reactive kva. reaches .25 kva. lagging for each full-load kilowatt, and to switch capacitors "off" when the reactive kva. reaches 0.1 kva. leading for each full-load kilowatt as indicated by the vertical dash lines shown on the curves. It will be noted that the plant power factor is unity at 25 percent load if the load power factor is 70 percent lagging. If the kilowatt loading is 50 percent, the plant power factor may vary from 90 percent lagging to about 98 percent leading. And at 75 percent kilowatt loading, the plant power factor may vary from 95 percent lagging to about 99 percent leading. For loads greater than 75 percent, the plant power factor will be improved more and closer to unity.

It will also be noted that if the load power factor of 70 percent remained constant while the kilowatt loading varied, then each of the two switched capacitors could be equipped with current actuated relays and accomplish practically the same results as obtained with two-step reactive kva. control. In this case the current relay on the first switched capacitor is adjusted to switch its capacitor when the load current reaches a value corresponding with the point where the .5 kva.-lagging unit crosses the 70 percent power factor lines (or 50 percent load), and the current relay on the second switched capacitor is adjusted to switch its capacitor when the load current reaches a value corresponding with the point where the .75 kva. lagging unit crosses the 70 percent power factor line (or 75 percent load). Since the current relay should perform at a slightly lower value of current to disconnect the capacitor than to connect it to the circuit, the plant power factor would vary from 90 percent lagging to a small leading power factor at .5 kw. units representing 50 percent load. At 75 percent load the power factor would vary from 95 percent lagging to a slightly leading power factor; and of course for loads greater than 75 percent the power factor would be still further improved.

The multiple step capacitor control can be secured in two different forms. One where the capacitor installation is divided into the desired number of equal sections, and the other where the capacitor is divided into unequal sections. For example, the capacitor equipment might be divided into two unequal sections to obtain a maximum of three values of capacitor correction; three unequal sections to obtain a maximum of seven values of capacitor correction; and four unequal groups to obtain a maximum of 15 values of capacitor correction. The dividing of the capacitors into unequal sections so that a minimum number of switches can be used to obtain a maximum number of steps involves the undesirable feature of making momentarily large changes in capacitor correction during some of the switching operations. For example consider the case of using three switches to obtain seven different values of capacitor correction.

Switch A—14 percent capacitor correction

Switch B—28 percent capacitor correction

Switch C—58 percent capacitor correction

A Closed—14 percent capacitor correction

B Closed—28 percent capacitor correction

A & B Closed—42 percent capacitor correction

C Closed—58 percent capacitor correction

A & C Closed—72 percent capacitor correction

B & C Closed—86 percent capacitor correction

A, B & C Closed—100 percent capacitor correction

It will be noted that maximum disturbance will take place when switch-

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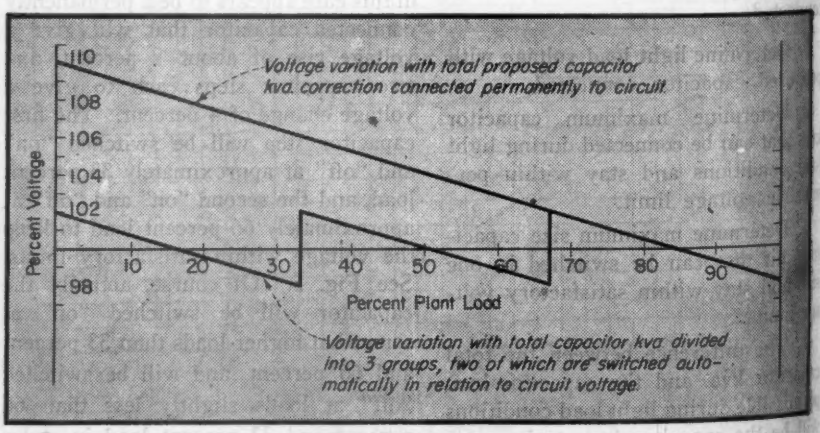
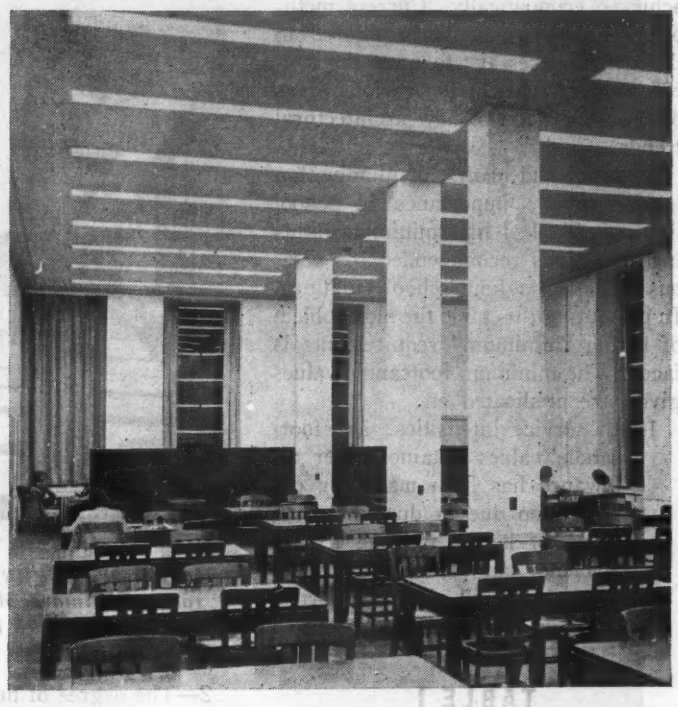


FIG. 5 Voltage variation with load after capacitors are added to correct for various load conditions as the load varies from zero to full load.



DIRECT FLUORESCENT LIGHTING troffers produce 35 footcandles of uniform illumination in study hall at Skidmore College, Saratoga Springs, N. Y. Room is 34 feet wide, 75 feet long, with 14½-foot ceiling. There are twelve rows of troffers equipped with 40-watt lamps.

Lighting Techniques for tomorrow's modern schools must provide efficient, glareless, high intensity illumination economically.

SCHOOL Lighting Techniques

By Berlon C. Cooper

GOOD lighting is an important and necessary adjunct to the modern school. It makes the school plant more useful to the community. It makes these facilities available for civic, cultural, and recreational, as well as educational purposes.

As of V-E Day, an expenditure of more than a billion dollars for future school construction had been planned. This construction will begin as soon as materials and manpower are available. Approximately 5000 major school structures are involved, with additions to existing buildings accounting for about half of the program. Sites have already been obtained, and architects selected, for more than 1200 new projects.

Most communities will finance their school programs with Federal assistance for at least 50 percent of the total cost. Structures and related mechanical equipment proposed will be examined carefully by Governmental reviewing agencies. It is therefore doubly important that sound engineering and economic practices be followed in the selection and application of such equipment, including the lighting system.

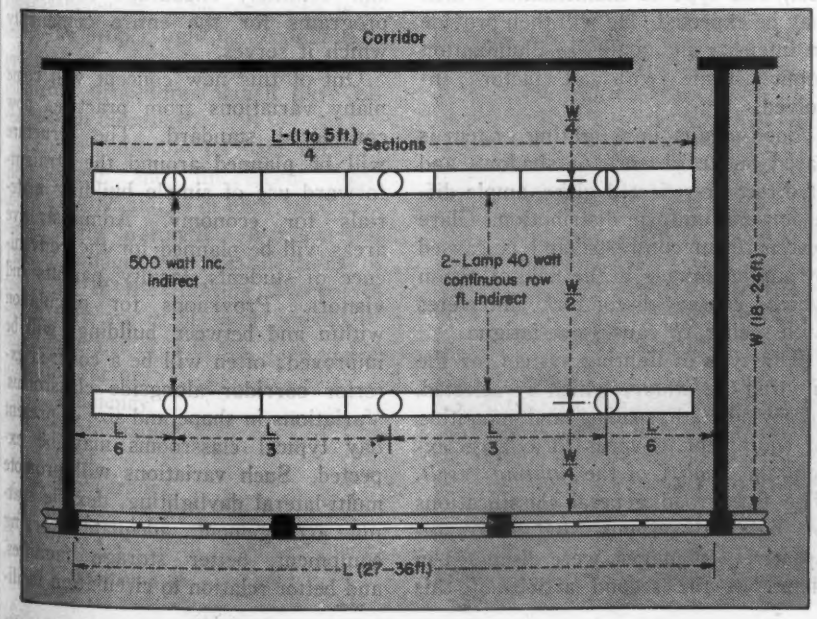


FIG. 1. LIGHTING LAYOUT for fluorescent or incandescent indirect lighting in typical classroom, which with white ceilings and light-colored sidewalls, will provide approximately 20 foot candles.

Artificial Illumination

Sound illumination fundamentals must be followed in lighting the schools of the future. Lighting techniques which implement these fundamentals must be used if adequate and satisfactory lighting results are to be

achieved economically. Current methods of lighting should be altered to the extent necessary to meet the *specific* requirements of the various areas of the school and of new architectural trends.

Quantity and *quality* of illumination is of primary importance in school lighting. Table I lists minimum lighting intensities recommended for various areas throughout school buildings. In presenting this table the old problem of listing "minimum" requirements is faced. The minimum footcandle values given are predicated on:

1—In service intensities; i.e., footcandle values obtained after allowance has been made for depreciation due to dust and dirt, aging of lamps, lighting fixture efficiency, and other similar factors which will obtain in normal use.

***INDIRECT INCANDESCENT LIGHTING** in Eastern High School classroom, Baltimore, Md. Fifteen 300-watt lamps in 23-ft. by 52-ft. room with 11-ft. 8-in. ceiling provides 40 footcandles of glareless, uniform lighting.*

TABLE I

RECOMMENDED MINIMUM LIGHTING INTENSITIES
For general illumination under operating conditions

Location	Minimum In-Service Footcandles
ADMINISTRATIVE	
Lobby	10
Offices	20
Teachers' Lounge	10
CLASSROOMS	
General	20
Art Rooms	20
Study Halls	20
Lecture Halls	15
Drafting Rooms	30
Sewing Rooms	30
Sight-Saving	30
Kindergarten	20
Nursery	10
Domestic Science	20
Manual Training, Shops	20
LABORATORIES	
Physics, Chemical, Etc.	20
AUDITORIUM	15
LIBRARY, READING ROOMS	20
GYMNASIUM (INDOOR)	30
CIRCULATION	
Corridors, Stairs, Etc.	10
SERVICES	
Cafeteria, Lunch Room	15
Locker Rooms	10
Toilets	10
Boiler Room	10

2—The degree of fine detail work to be done.

3—The quantity of light below which undue physical fatigue and lack of ease and speed of seeing would unduly hamper the student.

4—Safety, and promotion of orderliness and good housekeeping.

5—Conservation of eyesight.

Minimum footcandle values given should *not* be set as the illumination intensity goal. Higher intensities of proper *quality* will do much toward preventing eyestrain and eye-fatigue. The designer, having a full knowledge of all the factors of illumination design, will strive for optimum lighting results. He will study each area separately. He will take into account functional design, structural and finish details, economy of first cost and operating cost, and type of maintenance which may be expected. He will then provide an intensity and quality of illumination commensurate with all factors involved.

Good *quality* in a lighting system is based on an absence of shadows and of direct or reflected glare, ample diffusion and uniform distribution. Glare results from contrasts, and is caused by any brightness in the field of vision which causes discomfort, interferes with seeing, or causes eye-fatigue.

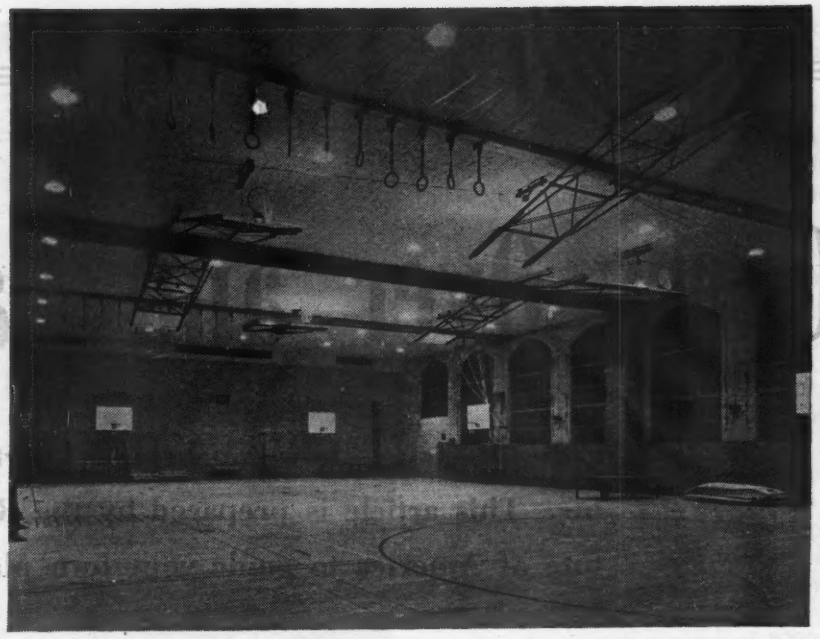
The type of lighting system, or the *lighting technique*, which is selected, combined with spacing and mounting of equipment, governs to a large extent the *quality* of the *lighting result*. The five broad general classifications of lighting systems, and their respective advantages, were discussed in detail in the second article of this series, published in the February, 1945 issue of *Electrical Contracting*.

New Concept

The architectural profession is developing a new concept of the school as an instrument of education. No longer is it considered, on the one hand, an excuse for a monumental building. Nor, on the other hand, is it primarily a group of one-room schools surrounding an auditorium, gymnasium, and indoor toilets. The progressive architect today recognizes the importance of safety, healthfulness and the aesthetic value of these structures on community pride. But most important of all, he recognizes that the real function of the school plant (buildings and grounds) is to make possible and definitely encourage educational programs for the entire community which it serves.

Out of this new concept will come many variations from practices now considered standard. The structure will be planned around the straightforward use of simple building materials for economy. Administrative areas will be planned for the convenience of students, faculty, parents and visitors. Provisions for circulation within and between buildings will be improved; often will be a covered exterior corridor alongside classrooms. Variations in shape and size of present day typical classrooms may be expected. Such variations will promote multi-lateral daylighting, flexible seating arrangement, adequate working equipment, better storage facilities and better relation to circulation facili-

LOUVERED DIRECT INCANDESCENT units produce average of 30 footcandes of diffused and uniform general illumination in Baltimore's Eastern High School gymnasium. Room is 80 feet wide, 129 feet long, with 25-foot ceiling. Forty 750-watt lamps are used. Welded concentric louvers also act as guards for reflector units. (upper right)



DIRECT LIGHTING with shallow bowl enclosing glass units adequately lights this 12-foot wide school corridor. (center right)

DIRECT LIGHTING with 18-inch dia. enclosing globes and 300-watt lamps produces 15 footcandles in this cafeteria. Units are easy to clean and surface brightness of glassware is under two candlepower per square inch. (lower right)

ties. Classrooms and laboratories will be more specifically designed for the various educational functions for which they are intended. Auditoriums will continue to provide flexibility for use as lecture rooms, dramatics, social gatherings and other similar functions. Changes will be made in libraries, reading rooms, gymnasiums, manual training shops and other school facilities to meet the specific needs of the communities in which they are located.

Selecting the Lighting Equipment

In planning school lighting, the most suitable lighting result for each area, such as those listed in Table I, must first be decided upon. Some of the more important areas are discussed separately below. The next step is to select the proper lighting technique to produce the desired lighting result, following procedures which have already been discussed.

A choice must now be made between incandescent and fluorescent light sources. Advantages of each were presented in the first article of this series. The advantages and qualifications of each, and of the lighting fixtures in which they are to be used, should be carefully considered in the light of the following factors:

1. Efficiency
2. Maintenance
3. Cost
4. Appearance

An analysis of the overall efficiency of the lighting system should be made,

[Continued on page 189]

TAX

Carry-Over and Carry-Back

Policy decisions now can bring important tax benefits. This article is prepared by the Research Institute of America to guide your own planning today.

WITH the end of the war in Germany, it becomes increasingly important for executives to test current operating decisions against certain special provisions of the tax law. The policy decisions you make *now* can materially increase or decrease the benefits your company will ultimately gain from (a) the loss carry-overs and carry-backs, and (b) the unused excess profits tax credit carry-overs and carry-backs.

If there is any *possibility* that your company will sustain a loss within the next few years, you cannot afford to disregard the refund opportunities presented by the *loss* carry-back. This is true whether you are operating as a corporation, partnership or sole proprietorship.

Even if there is no reasonable possibility of a loss, every *corporation* will still be interested in the *unused excess profits tax credit carry-overs and carry-backs,* which are brought into play whenever a corporation's income is less than its excess profits tax credit. In such a case it isn't necessary to establish a loss to gain the tax benefits.

Leave the technicalities of these tax provisions to your tax adviser. The technicalities will rarely affect the policy decisions which you, as the operating executive, will be called on to make. However, in order to make those decisions soundly, the executive must understand the general operation of the two types of carry-backs and carry-overs, and the legal and practical limits on their use. For the convenience of those who may not have this picture clearly in mind, a simple explanation is shown in panel.

Following are some of the basic policy questions which the tax carry-overs and carry-backs pose for the executives.

How the Carry-Backs Affect Current Operations

Key fact here is that the amount of tax refund your company ultimately gets may be determined by its taxable earnings *this year.* You will not be able to take advantage of the carry-backs unless you have earnings to carry back *to.* This point has been overlooked by many of the companies that have purposely held down their incomes because of the 95 percent excess profits tax and the scarcity of goods. A substantial number of these companies may find in 1946 or 1947 that they have either a loss or subnormal earnings (used in this article to mean that earnings are less than the excess profits credit). If they have no earnings for the two preceding years they will have nothing against which to carry back a loss. If they have no excess profits they will have nothing against which to carry back their unused credit.

Weigh this factor carefully in determining *today's* sales policies. Especially in industries where the future is problematical, *it may be advisable to remove all brakes on sales* even though that means subjecting profits to a 95 percent excess profits tax. Best procedure is to make a liberal estimate of any loss of subnormal earnings that might result from the end of war work or some such cause. Then make no effort to reduce your current income below the point at which a carry-back of such loss could be *fully* offset.

Of course, even if the carry-back cannot be fully utilized, there's still the carry-*over.* But there may be no income, or insufficient income, to carry over against. And in any event, repeal of the excess profits tax after the war would reduce the benefit from the loss carry-over and eliminate the benefit from the EPT credit carry-over.

RIA Recommendation: **These principles also carry a warning against indifference to current expenditures which are made only because there is a 95 percent excess profits tax rate. Many expenditures are being made now which have no other business basis than the fact that the government indirectly (through the loss of taxes) pays such a large portion of the cost. These expenditures cut down your carry-back "reserve" and therefore may be far more expensive than a 95 percent tax rate would seem to indicate.**

RIA Observation: **Both the President and War Mobilizer Byrnes were behind the proposal to permit large depreciation allowances in the first year in which new plant and equipment are acquired. If this goes into effect, many companies whose income would otherwise be too high to qualify will benefit by the carry-overs and carry-backs.**

Tax Factors in Your Reconversion and Postwar Planning

A typical case history shows the practical way in which an operating decision can be affected by the carry-back provisions of the tax law. Company X has not increased its sales force during the war years. It has decided, however, to take on a substantial number of new salesmen after the war for the marketing of a new

HOW THE TAX PROVISIONS OPERATE

How the LOSS Carry-Over and Carry-Back Work

There are a few exceptions, but generally speaking, the two-year loss carry-over and carry-back are available to *all* taxpayers, whether incorporated or not. Partners obtain the benefit as individuals; the partnership, as such, does not obtain any deduction.

When you have a loss, the carry-back is brought into play first. Any operating loss must be carried back two years and is deducted from income for that year. (For example, a loss in 1945 is first carried back to 1943.) If you were not in operation at that time or had no income or had insufficient income to absorb the entire loss, the remaining loss is then used to offset income in the first year preceding the loss (1944). If your loss is still unexhausted, you carry it forward to the first year after the loss (1946). Any portion of the loss still unexpended is carried forward to the second year after the loss (1947). In other words, the utilization of the loss is always in chronological order, first offsetting income, if any, in the second year preceding the loss and then moving progressively forward until the loss is completely offset by taxable income or you have reached the end of your two-year carry-over period.

You obtain the benefit of the carry-back by claiming a tax refund for the year to which the loss is carried back. Any loss carried forward is taken as a deduction in the year to which it is carried forward.

RIA ILLUSTRATION: A corporation has income of $100,000 in each of the years 1943, 1944, 1946, and 1947. It has a loss of $500,000 in 1945. After it has computed its loss for 1945, it can claim a refund of income and excess profits taxes paid for 1943 and 1944. Since this has eaten up only $200,000 of the $500,000 loss, it still has a loss carry-over of $300,000. It utilizes this carry-over to offset the $100,000 income for 1946 and the $100,000 for 1947. That is the limit of the carry-overs and the carry-backs from 1945.

How the Unused EPT Credit Works

These are more common and can be more important than the loss carry-overs and carry-backs, since no loss need be sustained to bring them into operation. (One corporation has already received a refund and credit of almost a million and a half from this source.) But since only corporations are subject to the excess profits tax, *only corporations can utilize the unused EPT credit carry-overs and carry-backs.*

Fundamentally, the unused EPT credit carry-overs and carry-backs work in much the same manner as their loss counterparts. If, in a particular year, a corporation's earnings are less than its EPT credit (and remember that this credit does not include the $10,000 exemption), it can carry back the unused portion of the credit to reduce excess profits taxes paid in the two preceding years. If the carry-back does not fully exhaust the unused credit, then a carry-over is permitted to the two subsequent years. Again the carry-back must be utilized first, and both the carry-back and carry-over must be in chronological order.

RIA ILLUSTRATION: A corporation has an EPT credit of $100,000. It had an excess profits net income of $150,000 in 1944, $110,000 in 1945, $25,000 in 1946, $150,000 in 1947, and $125,000 in 1948. The corporation may carry back its 1946 unused EPT credit of $75,000 so as completely to wipe out its excess profits tax for 1944 and 1945, and carry over the remaining $15,000 of unused excess profits credit to offset that much of its 1947 excess profits net income. It has then exhausted its unused EPT credit.

line. A month's training would adequately prepare these salesmen for the field; but a four-month training period would develop a much better and more profitable sales department from a long-range point of view. The difficulty is that the extra three-month period of training will result in the company's sustaining a loss or earning subnormal income. Under ordinary conditions, this might influence Company X to adopt the shorter training period. However, in view of the carry-backs to which Company X will be entitled if it suffers a loss or earns subnormal income, the decision might well be to embark on the four-month training period.

Remember that *any type of deductible business expense* can create a loss or subnormal income which yields a carry-back. Thus, it may be advisable for you to engage in advertising campaigns, market surveys, experimental and research programs, plant and equipment repairs, employee training and welfare programs, etc. Such expenditures may turn out to be profitable when you consider both the carry-back refunds they will make available and the substantial long-range benefits they can bring to your company.

RIA Illustrations: A company faces the choice between: (a) a three-month reconversion period which would give it just enough time to swing into the production of prewar models; or (b) a five-month reconversion period which would allow it to produce a new, improved model. Suppose that the first alternative could reasonably be expected to yield a profit of $100,000 in the first postwar year, but if the company should take five months for its reconversion, it could hope only to break even.

Based upon an income of $200,000 and an excess profits credit of $100,000, this company's taxes for each of the last two years were: normal tax and surtax—$44,000; excess profits tax—$76,950 ($85,500 tax less 10 percent postwar refund).

Assuming these figures, here is the net difference in taxes that would result under the alternative situations described above:

1. *Under the estimate for three-month reconversion,* assuming that there is no longer an excess profits tax, $60,000 would be left after taxes (the $100,000 less the 40 percent normal tax and surtax).

2. *Under the estimate for five reconversion,* the company would obtain a net refund of *$40,950* ($76,950 less 40 percent income tax on $90,000) due to the carry-back of unused profits credit.

In other words, the $100,000 profits which the company loses through the extra two-month reconversion time costs only $19,050 ($60,000—$40,950). Thus, the company will have to decide whether it is worth $19,050 to turn out an improved product.

RIA Recommendation: **In making these expenditures, be especially careful to distinguish deductible current expenses from capital items. In view of the obvious possibilities for abuse, the Treasury will be especially wary of capital expenditures treated by the taxpayer as current expenses in order to increase the carry-backs.**

Shifting to a New Peacetime Business

In the days ahead the situation of a war producer who changes to the man-

[Continued on page 194]

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

PRACTICAL METHODS

METAL CANISTERS SAVE PORTABLE DRILLS

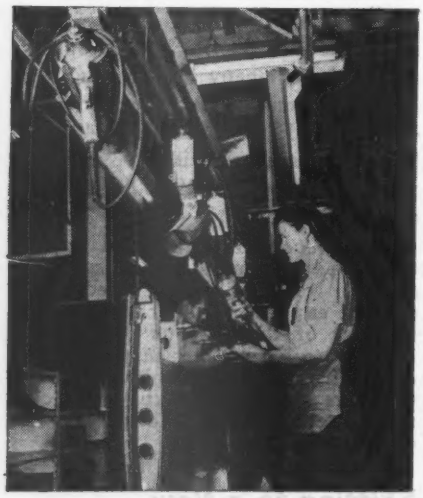
INDUSTRIAL

What to do with portable electric drills and tools temporarily not in use on a busy production line? Parking them on the floor would invite broken twist drills and cracked motor cases—a possibility that cannot be tolerated these days when equipment is so difficult to get. Such tools are an important item to plane plant assembly lines. Aside from possible production loss, damaged electric tools can produce a mighty expensive maintenance load.

It didn't take long for an ingenious member of the North American Aviation, Inc., electrical department at the Texas plant to solve this problem. He devised a metal canister which not only suspends the idle drill within easy reach of the assembly line worker, but also protects the motor case from mechanical injury. Simple in design, the device consists of a sheet metal cylinder with a slot cut in the underside to accommodate the pistol-grip of the drill. The canister is bracket-mounted, at an angle of approximately 45 degrees (upward tilt keeps drill from sliding out) to the trolley assembly which rides a feeder duct directly over the center of the assembly line. Drills are inserted into the canister "chuck-up" to prevent the trigger switches from operating. The trolley assembly, in addition to the contact wheels, includes a fuse box with a three-wire, grounded receptacle into which the drill cord is plugged.

Mounted 5-ft., 9-in. above the floor level, the canisters provide a convenient "pocket" into which drills can be placed while assemblies are adjusted and mounted on the jigs. Also, shorter cords can now be used on the drills.

The same principle is applied to "stationary" stations where there is no overhead trolley duct and where the jigs remain in a fixed position. Here, the canisters are mounted to a fixed bracket adjoining a Reelite which feeds cord to the drill as it is used anywhere within a limited area of the connection point. When the drill is "pocketed" in the canister, the Reelite takes up the slack cord. This scheme saves considerable time frequently wasted in untangling long drill cords and obviates the need for installing several plug-in receptacles along the comparatively short work line.



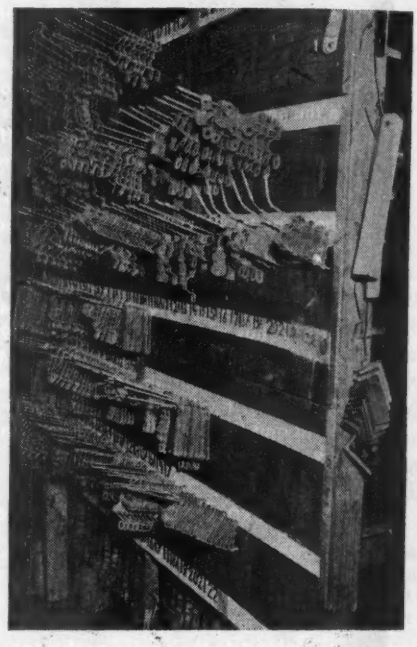
METAL CANISTERS mounted to overhead trolleys keep idle electric drills out of the way and free from mechanical damage along this master pick-up line for fins and stabilizers at the Texas Division of North American Aviation.

SHOP RACK FOR FABRICATED STRAPS

WIRING

When the Tri-State Armature and Electric Works at Memphis, Tenn., sets out to do a job, operating efficiency is uppermost in the minds of the management. Any innovation, no matter how small, that will speed up the work, save time, confusion and worry, receives careful consideration.

When they took on the contract to wire LCT craft, on a mass production basis for a Memphis shipbuilder, they found it necessary to use 800 cable straps per ship—some 400 of which had to be fabricated in the field shop.



FABRICATED CABLE STRAPS are racked near door of field shop. Straps are stamped with identifying numbers designating cable groups on which they are to be used. Same number appears on rack above each pin full of straps.

Many of these were of different size and type and presented a storage as well as a sorting problem. The main thought was to have all straps easily accessible to the workman and those of identical nature separate and identified. Boxes and cartons would have been cumbersome and inadequate.

A double-face wood rack was the answer to the problem. Mounted adjacent to the painting department and near the "outgoing equipment" door of the field shop, it is accessible to all workmen going out to the job, or to the "runners" employed to keep the men on the ships supplied with materials at all times. Just across the aisle from the rack is the fabricating bench where the special straps are field fabricated to fit the specific applications on the ships.

Into the backboard of the rack are driven several horizontal rows of long steel pins. Directly above each row of pins is painted a white stripe on which identifying numbers and letters—cor-

ADVERTISEMENT

SYLVANIA NEWS
CONTRACTOR EDITION

JUNE *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Salem, Mass. 1945

PUBLIC ENDORSES FLUORESCENT LIGHT

Wide Use in Homes Indicated by Survey

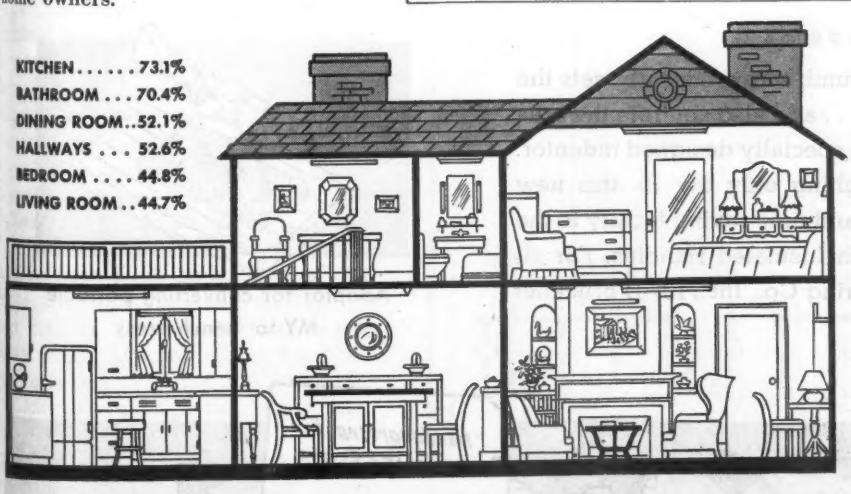
"In what rooms do you think fluorescent lighting is suitable?"

The answer: Kitchen—73.1%, Bathroom—70.4%, Hallways—52.6%, Dining room—52.1%, Bedroom—44.8%, Living room—44.7%.

This was one question asked recently in a nationwide survey conducted by one of the country's leading market research organizations for Sylvania's Sales Research Department.

Ever since the industrial-commercial world accepted fluorescent as the ideal light source, home owners have been changing their ideas about domestic lighting. Through national advertising and the distribution of educational material, Sylvania has been taking concrete steps in bringing this change about.

So that now the "average person" is receptive towards fluorescent lighting in his own house. Contractors have here an opportunity to enter a vast new field for fluorescent lighting installations, as soon as conditions permit the construction and remodeling planned by millions of home owners.



HIGHER RATINGS SCORED BY 20W AND 40W LAMPS

Chart Shows Increased Operating Efficiency In Popular-Sized Fluorescents

LUMEN OUTPUT OF SYLVANIA FLUORESCENT LAMPS

LAMP	COLOR	Total Lumen Output (after burning for 100 hrs.)		Approx. % of initial lumens/watt at 70% of rated life		
		Previous	New	Rated Avg. Life	Cycling	%LPW
20W-T12	White	860	880	2500	3 Hr.	84
				4000	6 Hr.	76
				6000	12 Hr.	70
40W-T12	White	2100	2160	2500	3 Hr.	84
				4000	6 Hr.	76
				6000	12 Hr.	70

Latest of Sylvania's fluorescent lamp lumen output and efficiency data—for two of their most popular sizes—is contained in the above chart.

This tabulation indicates a more accurate measure (based on indications from field performance) of the high performance that these widely-used T-12 lamps can achieve.

POSITION INDICATORS

In addition, these are two of the sizes that are fitted with one of Sylvania's most recent developments—the position indicator. Molded into the new plastic base, the indicators are placed on the shoulder of the cap at right angles to the pins. When the lamp is correctly inserted into the fixture one of these indicators points down. A touch of the finger is the only check required for precise positioning.

SYLVANIA ELECTRIC

MAKERS OF FLUORESCENT LAMPS, FIXTURES, ACCESSORIES; INCANDESCENT LAMPS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

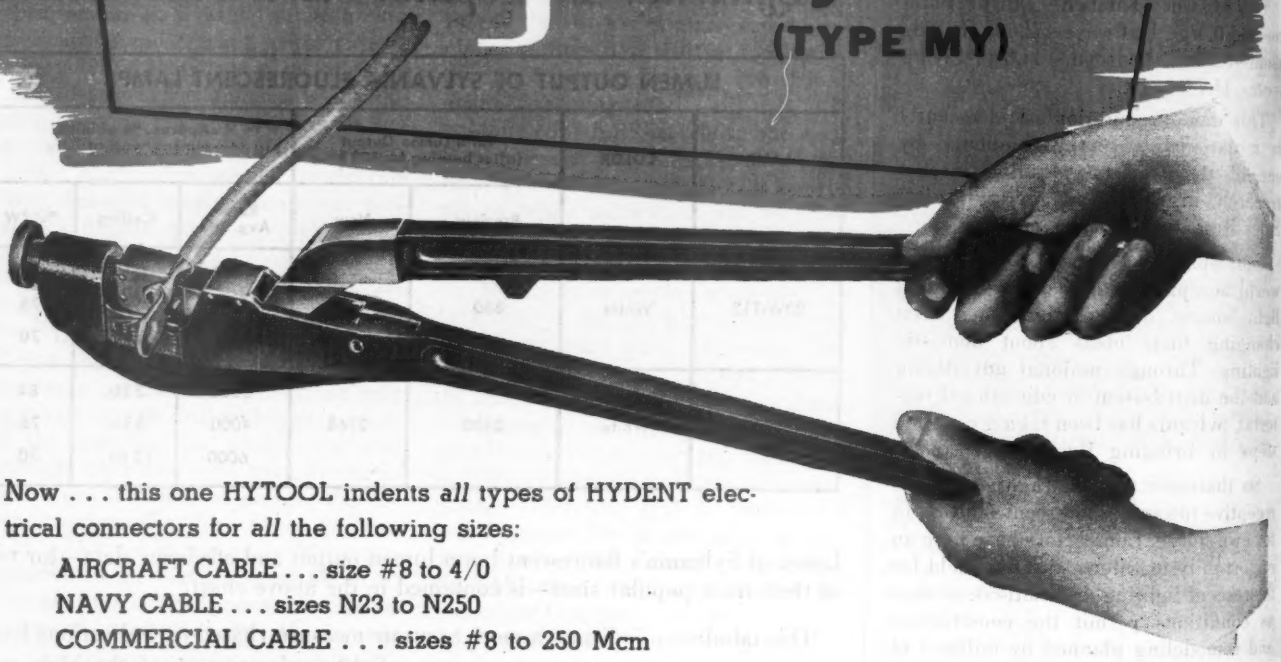
FROM NO. 8 WIRE TO 250 MCM CABLE

all

NOW INDENT CONNECTED WITH THIS NEW BROAD-RANGE

Burndy HYTOOL

(TYPE MY)

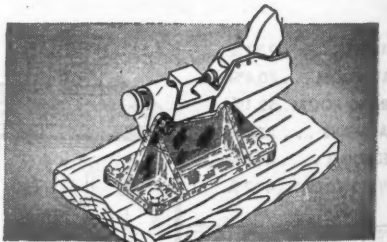


Now . . . this one HYTOOL indents *all* types of HYDENT electrical connectors for *all* the following sizes:

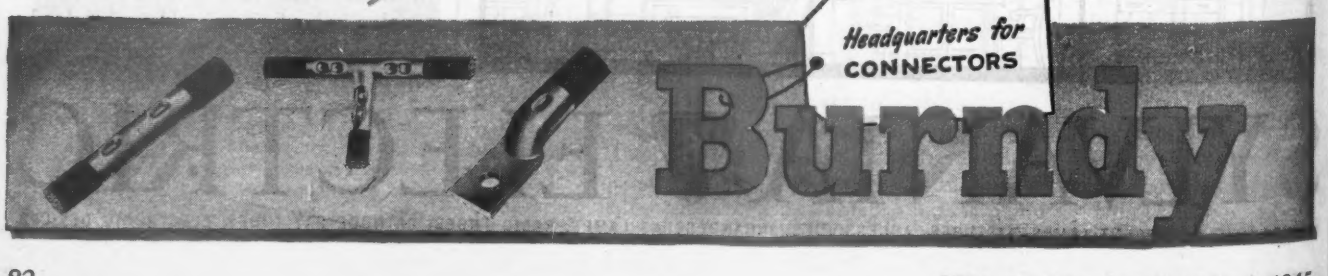
AIRCRAFT CABLE . . . size #8 to 4/0
NAVY CABLE . . . sizes N23 to N250
COMMERCIAL CABLE . . . sizes #8 to 250 Mcm
FLEXIBLE, EXTRA FLEXIBLE
and WELDING CABLE . . . sizes #8 to 4/0

Just one setting of the graduated thumb-screw instantly *sets* the nest for the correct connector size . . . and also controls the *area* and *depth* of the indent made by the specially designed indentor.

Entirely self-contained and weighing only 6½ lb. this new HYTOOL brings new convenience and time-saving facility to the connecting job. Also available with Insulated Handles. For all the facts, write . . . Burndy Engineering Co., Inc., 107-D Bruckner Boulevard, New York 54, N. Y.



Adaptor for converting portable MY to bench press



responding to those stamped on the metal straps—are painted or stenciled. These numbers designate the circuit and location on each ship where the various straps are to be installed—a coding system inaugurated to speed up the ship wiring by eliminating confusion, non-productive labor and the attendant drop in efficiency when men have to hunt for specific fittings or straps.

Pulling storage boxes or cartons from shelves, rummaging through them and other wasteful motions are entirely eliminated in this field shop. Thousands of straps are neatly aligned on the rack, clearly identified, within full view and easy access to all workmen—a unique sample of good shop housekeeping on the job.

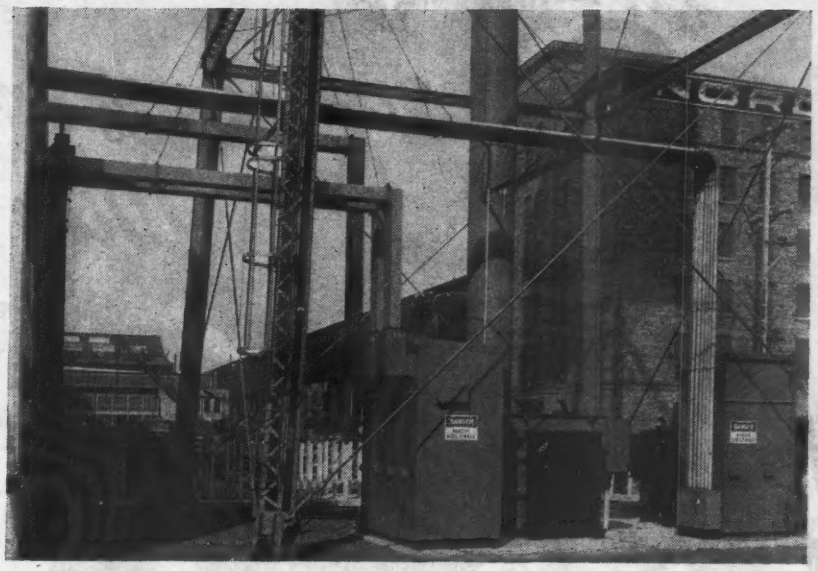
SUBSTATION UNDER WATER TOWER

WIRING

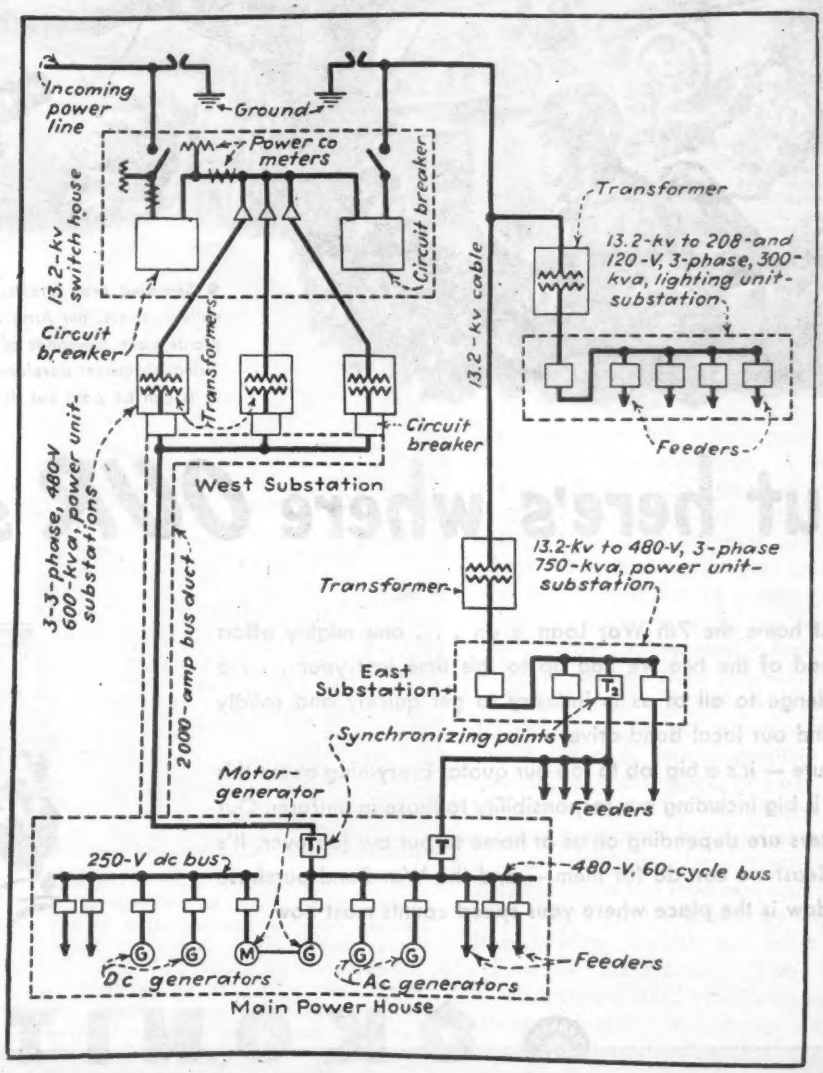
When, in 1942, the Nordberg Manufacturing Co., Milwaukee, was granted authorization to expand its production facilities to increase war production output, space for expansion of the electrical system was at a premium. The existing power plant could not accommodate additional generating units; there was not enough available space on which to build a new power plant; additional generating units could not be obtained in time and the plant's own production facilities were required for war demands thus precluding the construction of one of their own units for this purpose. Thus, arrangements were made with the local utility company to purchase the necessary additional power.

Two outdoor unit substations were required to provide the added capacity. It was difficult to find adequate space even for this equipment. Finally, it was decided to locate one of the substations underneath an existing water tower—thus utilizing space that normally was wasted. Known as the East Substation, this unit includes a 13.2 kv./480 v., 3-phase, 750 kva., power transformer with secondary switch-house, and three 1200 amp. outdoor bus duct feeders (one connecting to the power house alternating current plant generator bus); and a 300 kva., 13.2 kv./208/120 volt lighting transformer with secondary switch-house and feeders for lighting service. Trapeze hangers suspended from the water tower structure were used to support the three power bus ducts and seven lighting conduit feeders.

The second unit substation, located about 300 feet from the power house



UNDER A WATER TOWER—outdoor substation occupies space formerly wasted. High voltage feeder is on pole at right with underground feed to transformers. Power cubicles are at left; lighting at right.



CIRCUIT DIAGRAM showing the tie-in between the plant generating system and the two outdoor substations supplying the necessary additional purchased power. Breakers T_1 and T_2 are the tie breakers on the secondary system. Motor-generator set in power house utilizes any excess direct current generating capacity that might appear at certain periods.

● *Skimming over forests, jungles or open country . . . hurdling mountains, valleys, rivers, our Army Air Forces can lay combat telephone wire (Okonite plants make thousands of miles a month) at speeds up to 110 miles an hour. Using equipment developed by the Signal Corps, two continuous five-mile circuits can be paid out during a single flight of a light "grasshopper" plane.*

but here's where *OUR* speed counts

● **At home the 7th War Loan is on . . . one mighty effort instead of the two we had up to this time last year . . . a challenge to all of us in industry to get quickly and solidly behind our local bond drive.**

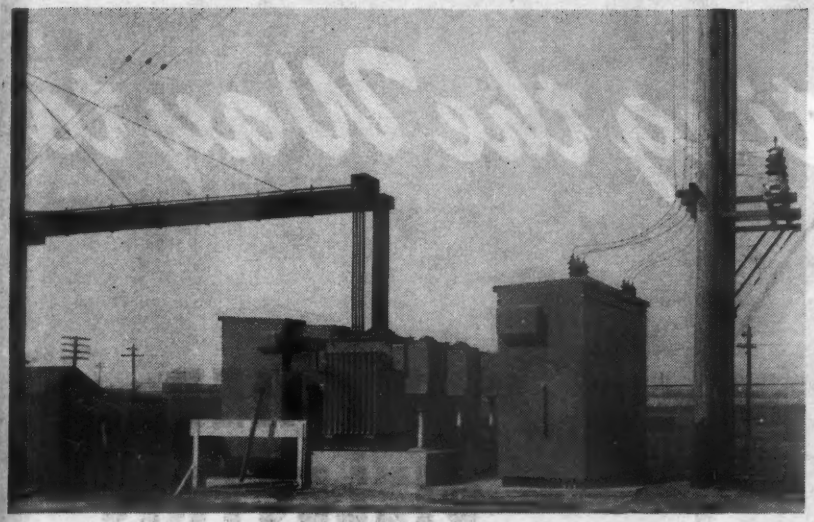
Sure — it's a big job to top our quota. Everything about this war is big including our responsibility to those in uniform. Our fighters are depending on us at home to put our job over. It's the least we can do for them — and the War Bond purchase window is the place where your speed counts most now.

OKONITE SINCE 1878

OKONITE

insulated wires and cables including combat wire

The Okonite Company, Passaic, N. J. • Okonite-Callender Cable Co., Inc., Paterson, N. J. • Hazard Insulated Wire Works Div., Wilkes-Barre, Pa.



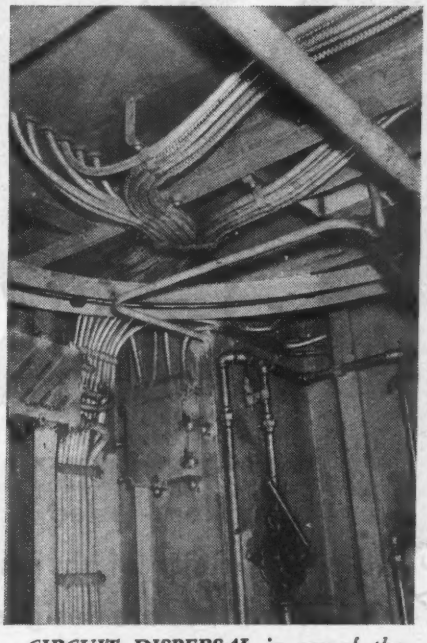
POWER UNIT SUBSTATION with incoming high voltage switch-house at right. One circuit breaker feeds substation under water tower. Note the I-beam (at left) supporting the 35-foot span of 2000 ampere, 480 volt bus duct and control circuit conduits going to power house.

and known as the West Substation, contains a 4-section, 13.2 kv., incoming line switch-house with the necessary power company meters; one circuit breaker to feed three, 3-phase, 600 kva., 13.2 kv./480 volt power transformers and secondary switch-house; and one breaker to feed the East Substation. The three secondary switch-houses are tied together by a 2000 amp. outdoor bus duct which connects to the 480 volt alternating current generator bus in the power house.

Centralized electrical control of all main circuits in the outdoor substations as well as automatic load control of other circuits is provided by a control cubicle in the power house switchboard.

One salient feature of the plant generator and utility tie at Nordberg is the means of insuring continuity of service during an outside fault. Instead of opening the main incoming breaker on an outgoing fault current (usually done to prevent the plant generators from feeding the fault, and to avoid serious drops in generator voltage), the system is split at two *inside points*—breakers T_1 and T_2 (see diagram). If these breakers are tripped, the utility can still keep all the East Substation feeders "hot" without dropping load from the generator switchboard.

Actuated by energy from current and potential transformers connected to the incoming breaker in the West Substation, 13.2 kv. switch-house, are directional relays in the power house switchboard control cubicle. Whenever the system splits an alarm is sounded; then the outside power system is again synchronized with the plant system through breaker T_1 or T_2. Another automatic control prevents splitting the system when the plant generators are not in operation. To provide additional flexibility of control, all essential breakers are operated by direct current supplied by a control battery in the power house. All of these features facilitate handling any emergency with a minimum of delay—a vital consideration when war production must be kept to a rigid schedule.



CIRCUIT DISPERSAL in one of the deckhouses of an LCT landing craft. Feeder circuits come up from switchboard in engine room below, enter watertight fuse panels on the bulkhead, or continue on to galley, pilot house and quarters where fuse panels with or without switches are located. Branch circuits leave fuse panels to serve electrical equipment on the craft. Marine cable is used throughout the ship and all connections are sealed and made watertight. This installation was made by the Tri-State Armature and Electrical Works, Memphis, Tennessee.

HANDY TRUCK FOR ELECTRICAL MAINTENANCE

MAINTENANCE

Shutdown periods due to changes or repairs to the electrical system must be held to an absolute minimum in busy warplants. Time normally spent gathering up tools and materials for each specific job must be eliminated, if possible. This has been accomplished in the efficient electrical maintenance department of the General Motors Corp., Allison Division Plant No. 5 in Indianapolis.

When a trouble call, or one for a shift of machinery, comes into Allison's electrical department, the maintenance crew takes its workshop, a portable combination workbench and parts cabinet, to the job site. Everything it may need is right on the spot.

The portable workshop is nothing more than a hand truck with a cabinet bench mounted on it. The complete assembly is 60 inches long, 30 inches wide and 39 inches high—providing ample working area at a convenient height. The top of the bench is clear with the exception of two vises, a pipe vise at one end and a machinist's vise at the other end (so located that two men can work at them simultaneously).

One side of the bench is constructed to accommodate the more cumbersome material items—conduit, wire, angle iron, hickeys, ladders, etc. Into the upper partition, four cardboard cartons of wire (each containing a 500-ft. coil) can be placed and lined up with four circular openings cut into the side of the truck to permit wire pay-out without kinking and snagging. A parallel section directly behind the wire compartment holds conduit hickeys and other "lengthy" material and tool items. The lower partition can hold several hundred feet of conduit ($\frac{1}{2}$, $\frac{3}{4}$, 1-inch). Two swinging-arm brackets (at the wire pay-out level) support one or more ladders when necessary.

The other side of the bench is a solid section of partitioned drawers, eleven in all. Here is kept a complete stock of small parts that might be used on the ordinary repair or "extension" job —an assortment of bolts and nuts, locknuts and bushings, conduit straps and hangers, reducing bushings and washers, conduit fittings, couplings, nipples, fuses, wiring devices, and other miscellaneous accessories. Two large lower drawers, fitted with locks, are for storage of large tool items such as electric drills, pipe threaders and cutters, reamers, knockout cutters and punches, fish tapes, and other necessary items.

Several of these portable workshops are maintained by the electrical depart-

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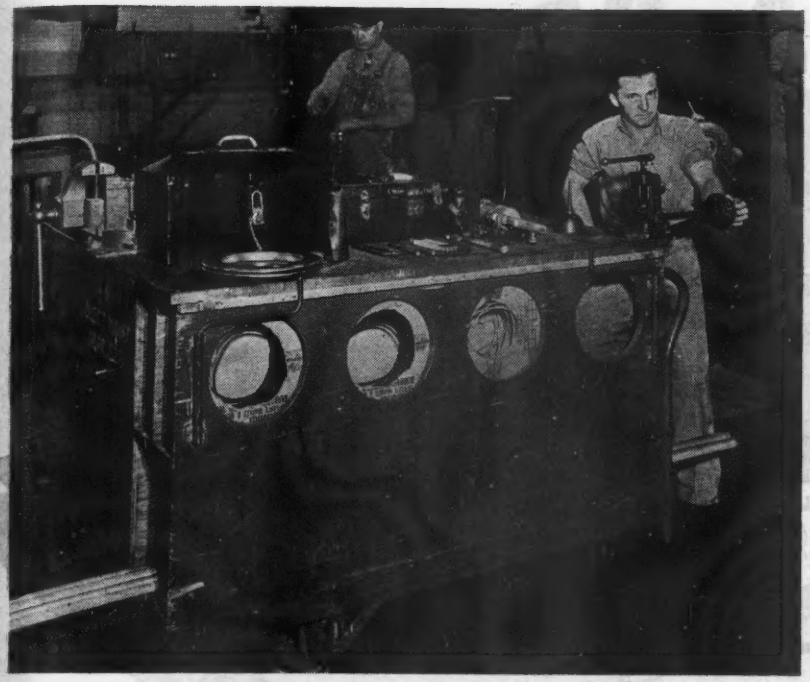

***PORTABLE WORKSHOP** carries all the material and equipment plant maintenance electricians at Allison Division, G.M.C., Indianapolis, might need for repair and extension work. Note conduit and wire storage feature and swinging brackets for ladders.*

***PARTS DRAWERS** on opposite side of truck contain the usual complement of nuts, screws, clamps, fuses, wiring devices, conduit accessories and heavy tools. Drawers are completely restocked at end of each shift.*

ment for plant maintenance work. At the close of each shift, the trucks are returned to the department and completely restocked with material items and expendable tool parts. Particular emphasis is placed on this "restocking" to keep the trucks ready for action at all times; to eliminate unnecessary "commuting" from the job site to the maintenance department for missing items. Similar portable trucks were designed for lighting maintenance only —equipped to handle fluorescent fixtures and accessories. These trucks are equipped with containers for water, cleaning compounds, washing and wiping cloths, spare fluorescent lamps and ladders. Savings in production shutdowns and electricians' time have more than compensated for the original investment in these portable electrical maintenance trucks.

CARBIDE MASONRY DRILLS SPEED CONSTRUCTION OF CONCRETE SHIPS

WIRING

Actual drilling time for the thousands of conduit holes required in concrete ships such as the "floating iceboxes" pictured in the accompanying illustration, has been reduced by 90 percent of the time previously required. This record achievement has been made by Concrete Ship Constructors, National City, Calif. In accomplishing this, the company employed a new type of masonry drill tipped with Carboloy cemented carbide.

Each concrete ship has 135,000 cubic feet of refrigerated space and requires some 4,000 holes from 1 inch to 2½ inches deep for electrical installations alone. Total number of holes drilled per ship is much higher.

Ordinary star drills were employed at the start of the contract. In an effort to speed drilling and save maintenance time, Carboloy masonry drills were tried. Ordinary portable electric drills were used for power. The Carboloy drills proved so successful that they were adopted as standard. Whereas the conventional star drill used to produce holes in these concrete ships (which were aged one to two months prior to the drilling) had to be continuously resharpened, the carbide-tipped masonry drills averaged around 300 holes for each sharpening of the carbide blade.

Secret of the new masonry drill's ability to cut holes through concrete faster than any other available tool lies in the blade inserted in the drill's tip. This blade is made of Carboloy

***CARBOLOY MASONRY DRILLS** permitted drilling of holes with portable electric or air-operated devices. About 300 holes, each from 1 inch to 2½ inches deep, were drilled in the concrete before drill sharpening was necessary.*

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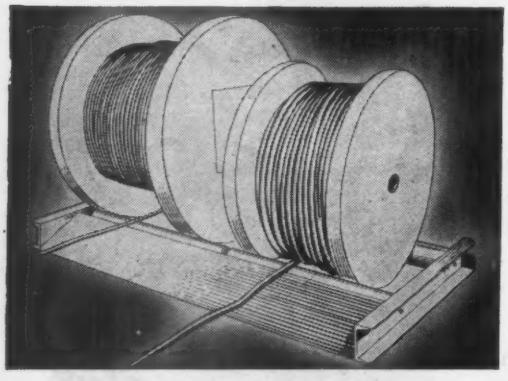

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Style B—reel width 48 inches. Cap. 4,000 lbs.—weight 110 lbs. Price $75.00 F.O.B. Cincinnati.

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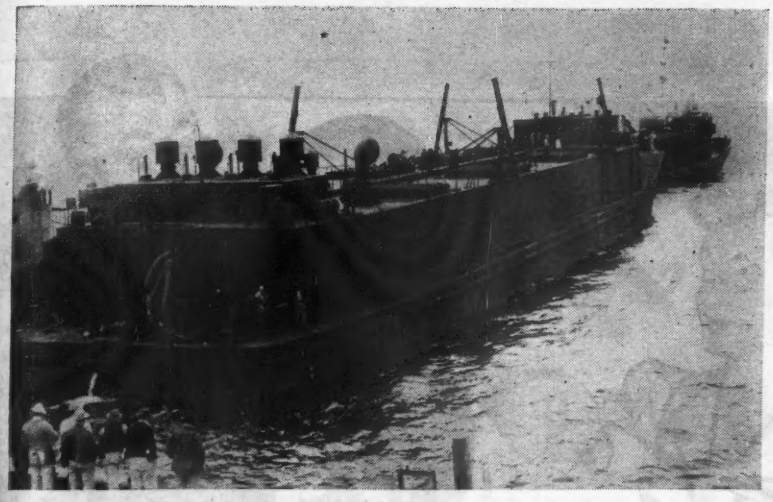


CONCRETE SHIP in which thousands of holes must be drilled for electrical wiring, and for other purposes. Carboloy cemented carbide drills have reduced drilling time by 90 percent.

cemented carbide, hardest metal yet produced by science and manufactured by Carboloy Company, Inc., Detroit, Michigan. The carbide is so hard (approaching the diamond in hardness) that it easily cuts through concrete, making possible the drilling of holes and doing away with the prolonged hammering customary with regulation star drills.

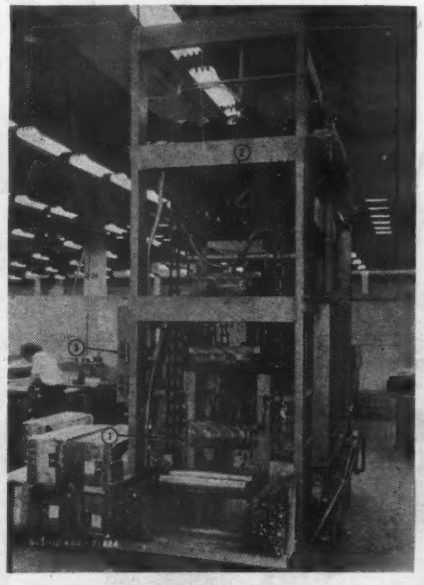
INFRA-RED SPEEDS RUST PREVENTIVE PROCESS

INDUSTRIAL

One of the final steps before aircraft parts are packed for shipment overseas, is the application of a rust or corrosion preventive coating to assure that all parts will be in perfect working order when received on the various battle fronts. There are numerous coatings and processes used for this purpose.

At General Motor Corp., Allison Division Plant No. 5 in Indianapolis, piston rings for the renowned Allison liquid cooled aircraft engine (produced at this plant) are given a protective coating of rust preventive Grease ES-16 just prior to packing for shipment. A special machine, designed and built for coating piston rings, incorporates infra-red tunnels as an integral part of the unit. In this specific application, the infra-red heat is used to remove all traces of moisture in the piston rings *before they are dipped* in the grease bath. If any moisture remained on the rings prior to the application of the grease coat, a certain degree of corrosion would still take place during shipment and the parts might arrive at their destination in a worthless condition.

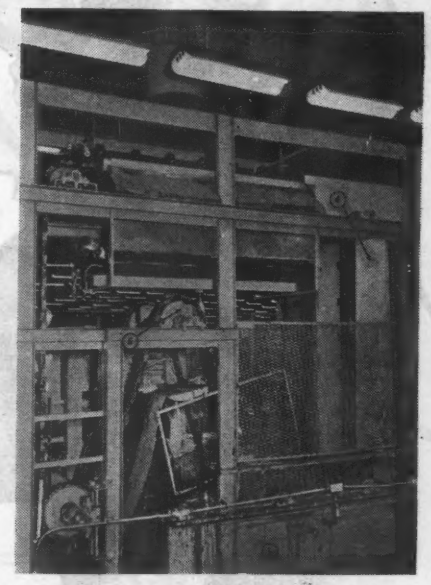
Heart of the machine is an endless chain conveyor which carries "sticks" of rings (40 rings to a stick) through the drying-dipping cycle. Rings are loaded on the conveyor at the front end of the machine (Fig. 1). They are carried up and across the unit through an octagonal tunnel containing three rows of 375 w., infra-red, carbon filament heat lamps in gold-plated reflectors (two rows near the base and one at the top of the tunnel); then down through a vertical tunnel comprised of six rows of lamps (45 lamps total including those at enclosed top of tunnel); then through the grease bath in a tank at the base of the machine. When the rings reach the grease bath, they have been in the heat tunnel 15 minutes (conveyor speed, 14 ft. per minute) which is ample time to remove all moisture that might have been present.



GREASE-COATING MACHINE carries piston rings through a drying-dipping cycle at Allison Division, G.M.C., plant, Indianapolis. Piston rings are loaded on conveyor at point (1) and go through first infra-red tunnel at (2). All electrical controls are mounted to machine at point (3). (Fig. 1)

After the grease bath, the conveyor takes the rings up one side of an incline—where four infra-red lamps are directed on the rings—and down the other side (Fig. 2) where the excess grease drips off and the rings are subjected to a certain degree of air drying. The coated rings are removed at the same point where the new rings are loaded on the conveyor. Packing and crating for shipment follows this coating process.

Total heating load on this unit is 25,125 watts (67 lamps). All lamps are used simultaneously, hence there is no variable circuit control. Six circuits serve the infra-red tunnels and scattered units (approximately 11 units per circuit).



SIDE VIEW OF MACHINE showing vertical drying tunnel (4) through which piston rings pass before receiving grease bath in tank (5). Coated rings are then carried up and down incline (6) before being unloaded at front of machine (point 1 in Fig. 1). (Fig. 2)

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ELECTRONICS

Installing, Maintaining and Servicing Electronic Resistance Welding Control—III

W. J. Gorman, Jr.
Industrial Control Engineering Div.
General Electric Company
Schenectady, N. Y.

SYNCHRONOUS starting and continuous heat control is often incorporated in electronic resistance welding controls to insure accurate timing. While it is possible to obtain a separate control to perform each of these operations, the type most commonly used with spot-welding controls consists of a single unit including the circuits of both.

To obtain consistent welding, especially when short timing intervals are used, it is necessary that each weld start at the same point in the current wave for each successive weld. If a welding machine is energized at any point in the current wave other than zero, a transient current will flow for the first few cycles. The magnitude of this transient will vary, depending upon the point in the wave at which the machine is energized.

Some welding machines employ a welding transformer with a tapped primary winding which can be used to obtain different weld currents. This method of heat control limits the number of possible heat settings to the number of transformer taps. The electronic method of heat control is preferred since it provides a continuous range of heat settings.

Adjustment

The cathode ray oscilloscope is essential not only for maintenance and servicing welding controls but also for properly making initial adjustments. Before operating a control for the first time, carefully read the instructions and wiring diagram which accompanies the equipment. Very few forms of control can be installed without making one or more initial adjustments.

Synchronous spot-welding control without heat control usually requires a synchronous starting adjustment. Since each welding machine differs in power factor, the starting must be adjusted to meet the power factor condition of the individual machine.

Panels employing heat control will require a full heat-limit adjustment which will also differ with the power factor of the welding machine. This adjustment involves setting a limit resistor, usually connected in series with the heat control rheostat, so that full heat is obtained at the 100 percent setting on the heat dial.

FIG. 1—Initial adjustments being made to welding control, using cathode-ray oscilloscope and multi-meter.

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Before attempting to maintain electronic welding controls, the serviceman should have a general knowledge of the circuit operation. The wiring diagram which accompanies each control will be found both useful and necessary in servicing this type of equipment properly. The diagram usually consists of an elementary circuit diagram and an actual wiring diagram. The elementary diagram is included to show the sequence of operation and to segregate the various circuits. In the case of the more complex controls, it would be almost impossible to identify the operation of the many circuits from the wiring diagram alone. For this reason, the actual wiring diagram should be consulted only when determining the physical location of circuit points that will be used in taking measurements or examining wave shapes. It should be remembered that on the elementary diagram the part symbols are located in the circuits in which they are used. The circuit points are connected together with the shortest possible lines and do not indicate the actual sequence of wiring.

To start, one should familiarize himself with the elementary diagram of the control to be serviced. This diagram should be studied and the component parts which comprise the timing, synchronous starting, and heat control circuits identified. Some diagrams are clearly drawn so that these circuits may be easily recognized, while others require a little pencil and paper work to separate these circuits.

There are many different circuits used in welding controls, and to explain the operation of all of them would require much space. However, many of these controls use the same type of tubes and employ the same sequence of operation. In the following paragraphs the operation of a typical control (Figs. 2 and 3) is described.

Rectifier Circuit

Many timing circuits require a d-c voltage to obtain the timing action. This d-c voltage is usually obtained by means of a transformer, a rectifier tube, and a filter circuit, or by means of a transformer and a copper-oxide rectifier. Faulty timing may result if some component of the rectifier circuit fails. A measurement of the d-c voltage with a voltmeter will usually indicate whether or not the rectifier is functioning properly. Also, it is a good policy to measure or examine the d-c voltage with a cathode-ray oscilloscope. The d-c output of a filtered rectifier should appear as in Fig. 4. The deflection should be upward if the positive scope lead is connected to the

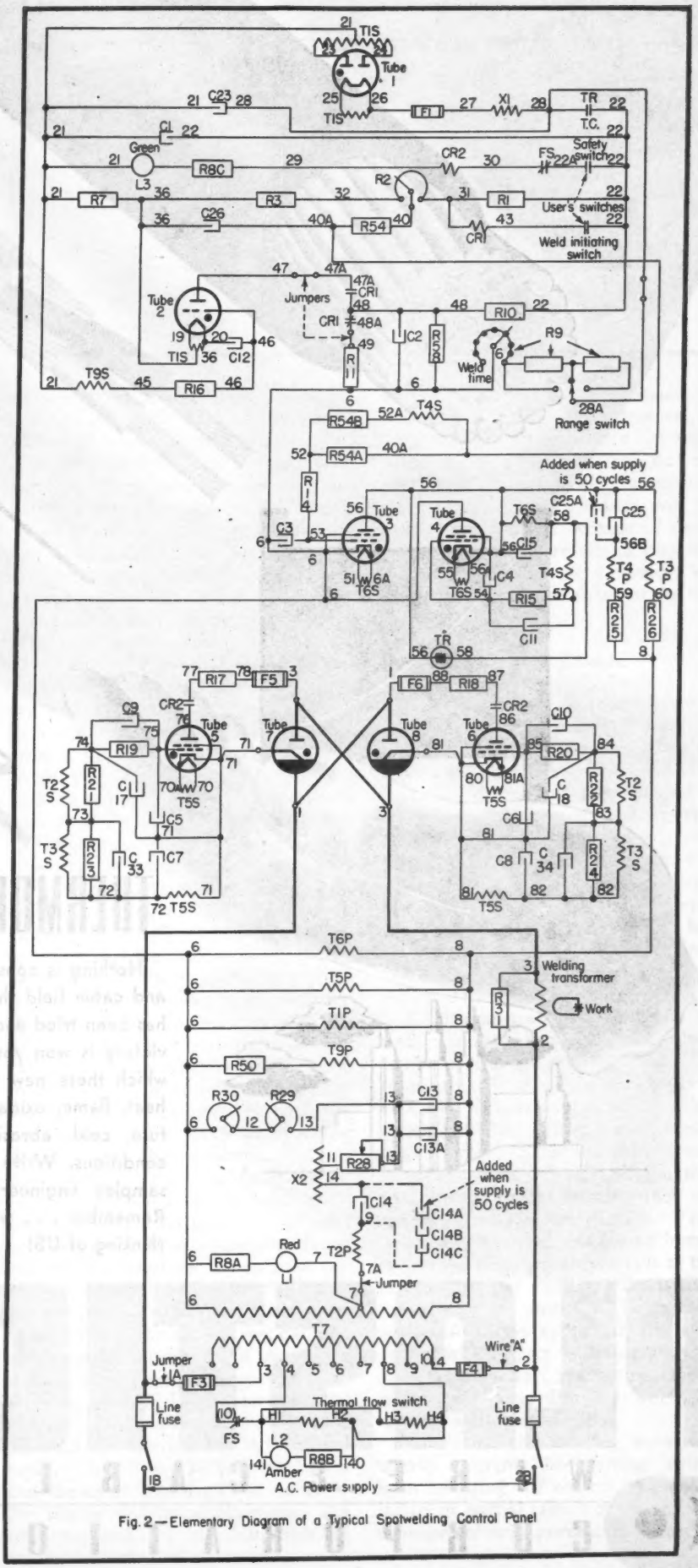

Fig. 2—Elementary Diagram of a Typical Spotwelding Control Panel

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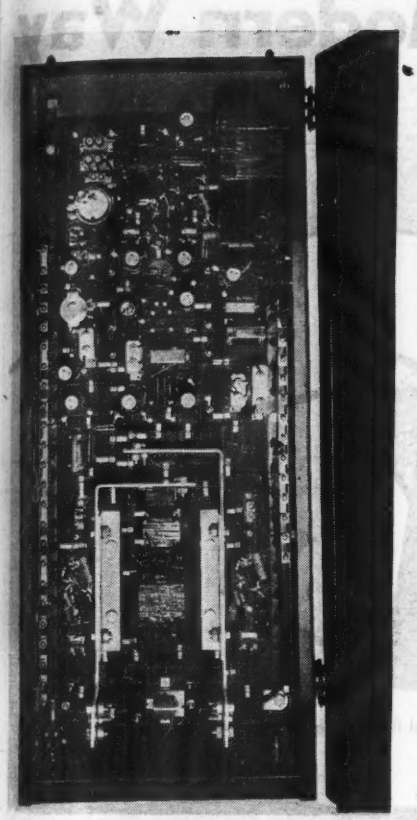

FIG. 3—Rear view of a typical spot-welding control panel.

Fig. 4—D-C Voltage

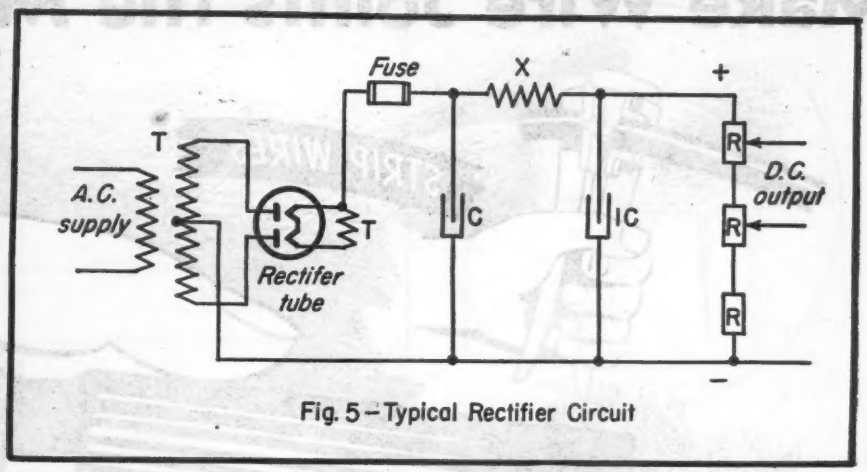

Fig. 5—Typical Rectifier Circuit

plus and the negative lead to the minus side of the d-c supply.

A typical tube rectifier circuit is shown in Fig. 5. A center tapped supply voltage is obtained with transformer (T) which also has a filament winding for the heater of the rectifier tube. The filter circuit consists of the two capacitors (C and 1C) and a reactor (X). A voltage divider made up of a number of resistors connected in a series is usually connected across the d-c output. The purpose of the voltage divider is to divide the total d-c output into smaller voltages.

Timing Circuit

There are many forms of timing circuits used in the various electronic spot welding controls. However, the most common circuits employ a capacitor and adjustable rheostat in the grid circuit of a vacuum or thyratron tube. The charging or discharging action of the capacitor is used to increase or decrease the grid voltage of the timing tube. Usually the grid circuit of a tube has a high impedance and is easily effected when voltmeters are connected to any part of the circuit. Since the cathode-ray oscilloscope has a high impedance input circuit (having little or no effect on the grid circuit), it is advisable to use the scope in checking the timing circuit.

A typical timing circuit operating from a d-c voltage is shown in Fig. 6. With the starting switch open, the cathode of the thyratron timing tube is connected through the timing rheostat to the positive side of the d-c supply. The grid is connected to a negative d-c potential and thus prevents the tube from conducting or firing. When the starting switch is closed, the timing capacitor and the cathode of the timing tube are suddenly connected to a point on the voltage divider more negative than the grid. In other words, the grid is now more positive than the cathode which permits the timing tube to conduct. The cathode side of the timing capacitor charges (through the timing rheostat) to the positive supply voltage. As the capacitor charges, the voltage of the cathode gradually increases until it is finally more positive again than the grid. This "sets-up" the tube to cease conducting. Turning off the thyratron timing tube can only be accomplished when the anode voltage is at zero potential. Since the anode circuit is an a-c voltage, the tube will stop conducting when the anode voltage goes through zero. The negative grid (with respect to the cathode) will continue to keep the tube off until the starting switch is closed again. This fires the tube as before and the cycle repeats. The value of the timing resistance determines the time required for the capacitor to charge. The greater the resistance, the longer will be the timing interval.

Erratic timing is usually the result of failure of the timing tube or some part in the timing circuit. In many instances, the timing rheostat will become open-circuited because of excessive wear, and this results in very long timing. Failure of the d-c supply will also cause continuous firing of the timing tube.

Starting Circuit

As stated before, to insure accurate timing, it is necessary to start the timing interval at the same instant for each weld after the starting switch is closed. This may be accomplished by connecting a thyratron tube in series with the starting switch. A typical starting circuit is shown in Fig. 6-A. Closing the starting switch applies a d-c voltage to the anode of the starting tube. The grid of the tube is held negative by a voltage from the voltage divider. For this reason the tube will not conduct.

A peaking transformer in the d-c grid circuit inserts a peaked voltage on the grid of the starting tube. This transformer is of special design giving a peaked voltage output which might appear as shown in Fig. 7 when viewed with a scope. Since the grid already has a negative d-c voltage, the total grid voltage on the starting tube will appear as shown in Fig. 8. From this it will be noted that for an instant the grid is driven positive. It is at this instant that the starting tube is fired and timing is started. The positive peak will always appear at this same instant with respect to the supply voltage and thus start the timing at this same point, regardless of when the starting switch is closed.

Failure of the starting tube will usually prevent the starting switch from initiating the control. Complete failure or partial failure of the peaking transformer will prevent the starting

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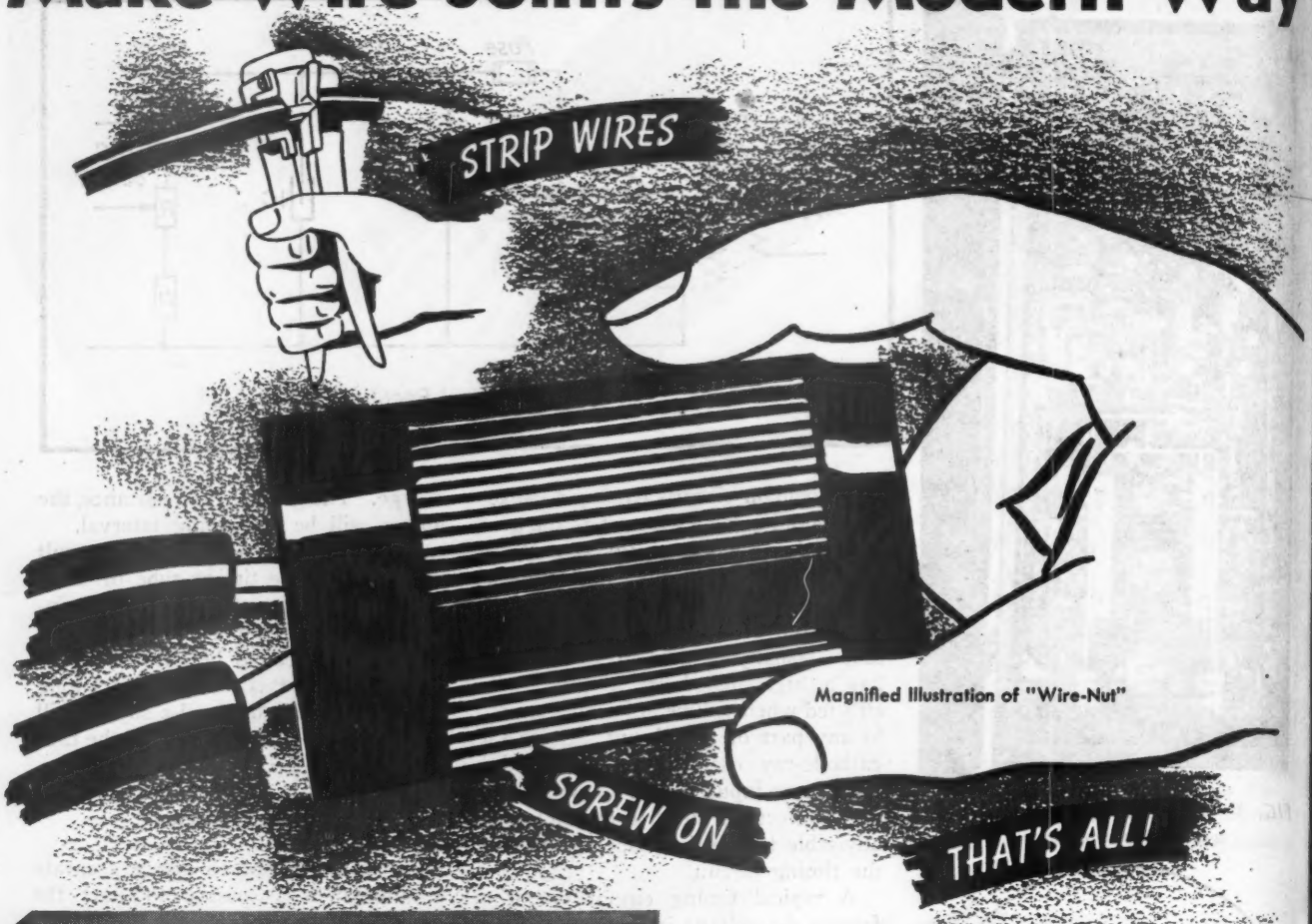

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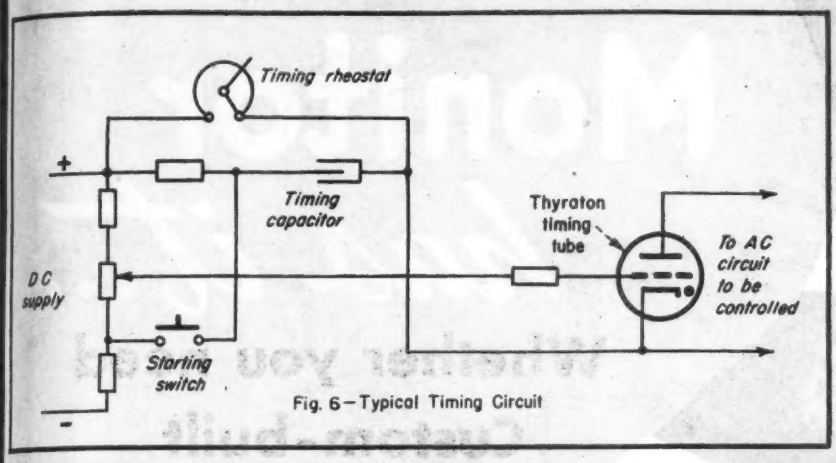

Fig. 6—Typical Timing Circuit

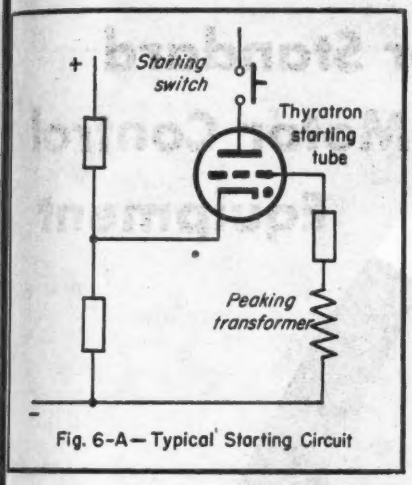

Fig. 6-A—Typical Starting Circuit

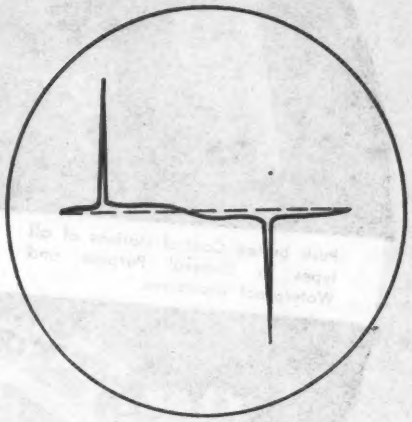
Fig. 7—Impulse or Peak Voltage

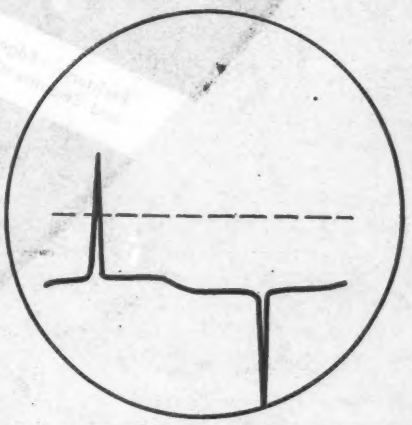
Fig. 8—Negative D-C Voltage and Peak Voltage

tube from initiating the timing circuit. On controls with heat control, the phase setting of the peak voltage is fixed. However, controls without heat control require adjusting the peak to the power factor of the welding machine. Improper adjustment of this peak voltage will result in transient currents during the first few cycles of weld current.

Trailing Circuit

The thyratron tube passes current in only one direction and only in that interval during which the anode is positive with respect to the cathode. Therefore, a thyratron tube when used on a-c voltages will pass current only for the positive half cycles during which the anode is positive. In welding control circuits where a-c voltages are used almost exclusively, it is necessary to use two thyratron or ignitron tubes in each circuit in order to pass a full sine wave a-c current. An inverse parallel connection is made by connecting the anode of each tube to the cathode of the other, as in Fig. 9. This connection commonly called "back to back" permits one tube to pass current in one direction and the other in the opposite direction.

The additional tube which is connected in inverse parallel with the timing tube is called the "trailing tube", because for each half cycle that the timing tube conducts, the trailing tube will conduct for the corresponding negative half cycle. Referring to Fig. 9, the inverse parallel connection of the thyratron tubes is used to fire or energize the two transformers 3T and 4T. Transformer 3T supplies the a-c "turn on" voltage to the firing tubes while 4T supplies a "turn on" voltage for the trailing tube. The grid circuit of the trailing tube is made up of a self-rectified bias voltage, hold-off voltage 6T, and a turn-on voltage 4T. The self-rectified bias is accomplished with a small resistor and capacitor connected in parallel, and is used to force the grid voltage negative slightly before the anode becomes positive. The hold-off voltage which normally prevents the tube from firing is supplied through transformer 6T from the a-c supply. The secondary of this transformer is connected such that the voltage is 180 deg. out of phase with the trailing tube anode voltage. Transformer 4T primary is connected in series with a capacitor so that the voltage lags from the first half cycle of the timing-tube conduction. This voltage is transformed to the grid of the trailing tube with a polarity that will make the grid become positive and cause conduction during the subsequent half cycle. By this means, the trailing circuit provides a timed sine wave voltage to transformer 3T. The secondary leads of 3T are connected to the grids of the firing tubes.

Loss of the supply voltage will prevent the timing and trailing tubes from conducting. Failure of the trailing tube or turn-on transformer 4T will result in failure to fire the corresponding firing tube. This will prevent one power tube from conducting, resulting in supplying half cycles to the welding transformer. These half cycles will be of the same polarity and will cause a direct current component to flow in the primary of the welding transformer. This d-c component will cause the transformer iron to saturate (indicated by a growling noise) and will eventually trip the line circuit breaker. The effects are the same with panels not having heat control since the timing and trailing tubes also act as the firing tubes.

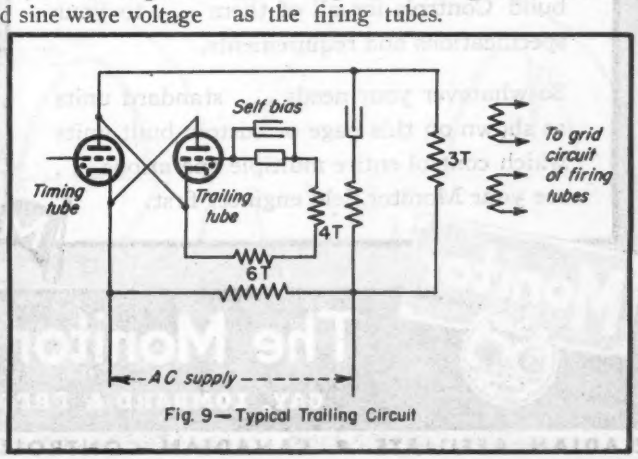

Fig. 9—Typical Trailing Circuit

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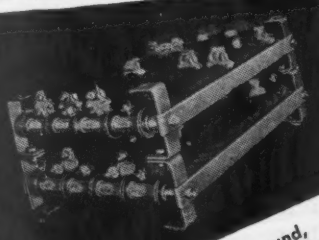

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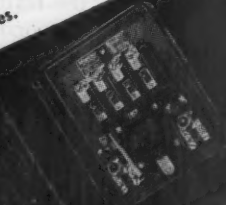

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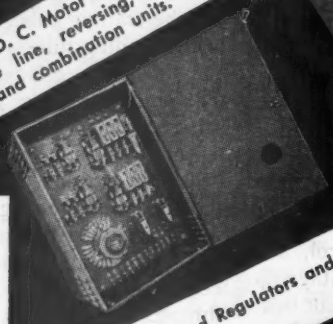

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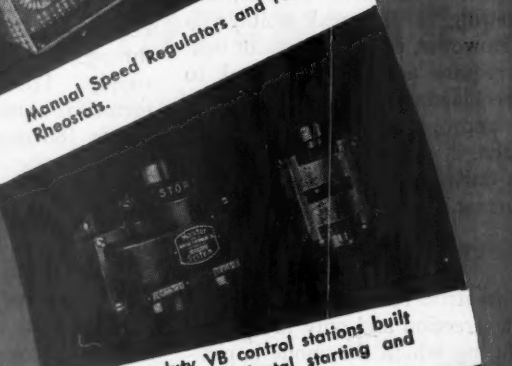

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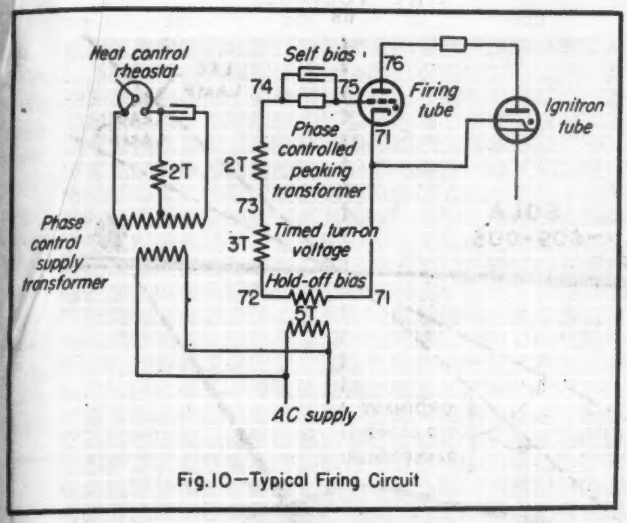

Fig. 10—Typical Firing Circuit

The firing tubes are used to cause the ignitrons to pass current for the time-interval setting of the timing circuit. These tubes may also be used to delay the firing of the ignitron tubes and thus provide heat control. This requires a separate thyratron tube to fire each ignitron tube. The grid circuit of each firing tube is identical except that each is operating 180 deg. out of phase with respect to the other. Each grid circuit usually consists of a holdoff bias voltage and a timed turn-on voltage. The hold-off bias may be an a-c sine wave or d-c voltage, while the timed turn-on voltage may be a pulse, sine wave, or d-c voltage. If heat control is employed, a phase-controlled sine wave or pulse voltage may be used to delay the firing of the tube. Other forms of heat control may employ a variable d-c voltage.

A typical firing circuit is shown in Fig. 10. The grid circuit consists of a self-rectified grid bias voltage, a-c sine wave hold-off bias voltage, timed a-c sine wave turn-on bias, and a peaked phase-controlled voltage. The self-rectified bias is obtained with a resistor and capacitor connected in parallel. The hold-off bias is supplied through transformer 5T from the a-c line. This voltage is 180 degrees out of phase with respect to the anode voltage of the firing tube. The timed turn-on voltage 3T is supplied from the timing circuit just described (see Fig. 9). The phase controlled peak voltage 2T (heat control) is supplied from the phase-shift circuit consisting of the center-tapped phase control supply transformer with rheostat and capacitor.

With the positive lead of an oscilloscope connected to the anode (point 76 in Fig. 10) of the firing tube and the negative lead connected to the cathode, (point 71) a single sine wave may be synchronized, as in Fig. 11. This indicates that the anode of this tube is positive during the first half cycle. If the *positive* scope lead is moved to the grid side of 5T (point 72) with the negative lead remaining at the cathode (71), the hold-off bias will appear as shown in 11-A. This shows that while the *anode is positive* during the first half cycle, the *grid is negative*. In using the oscilloscope for such tests, the positive scope lead should always be connected nearest the grid side of the voltage to be measured. This makes it possible to compare the grid voltage to the anode voltage which has been set up as a reference. If the timed turn-on voltage (across points 72–73) is examined, it will appear as the dotted sine wave in Fig. 12. The solid line in this figure represents the 5 percent hold-off bias.

Comparing the two voltages, it is easy to recognize that the purpose of the turn-on voltage is to cancel out part of the hold-off voltage during the timing period. During standby, the total grid voltage measured from the cathode side of the self-rectified bias (point 74) to the cathode (point 71) will appear as in Fig. 13. The peak voltage may be shifted along the 5T hold-off voltage by varying the heat control rheostat in the phase-shift network supplying power to 2T transformer. During timing, 3T voltage cancels out enough of the 5 percent voltage to allow peak from 2T to fire the tube. The phase setting of this peak determines the phase angle at which the firing tube will start conduction and thereby control the point in the cycle at which the ignitron power tubes fire. A maximum of full heat is obtained with the rheostat set so that each power tube passes current during its full half cycle. Any less amount of heat can be obtained down to zero percent by adjusting the rheostat to delay firing the power tube so that it passes current during only part of the half cycle when its anode is positive.

If, because of failure of the timing and trailing tubes, a turn-on voltage is not supplied by 3T, the firing tubes

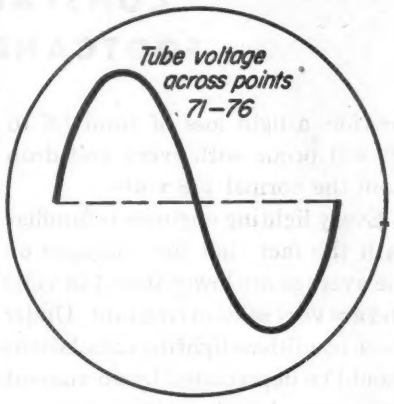

Fig. 11—A-C Sine Wave Voltage

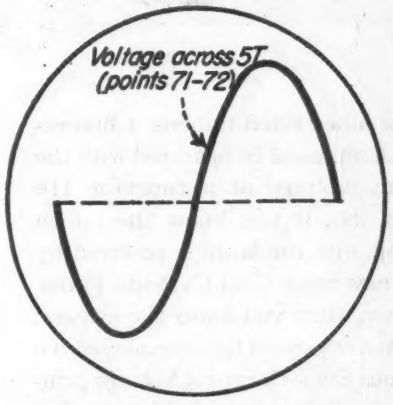

Fig. 11-A—A-C Sine Wave Voltage 180° out of Phase with 11

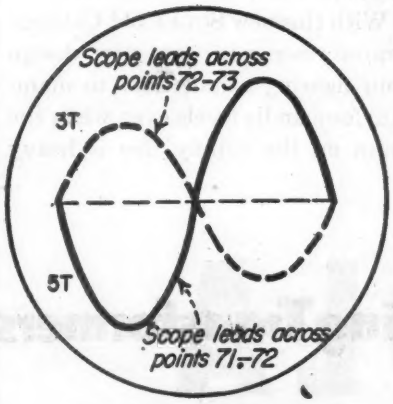

Fig. 12—Phase Relationship Between Two Grid Voltages

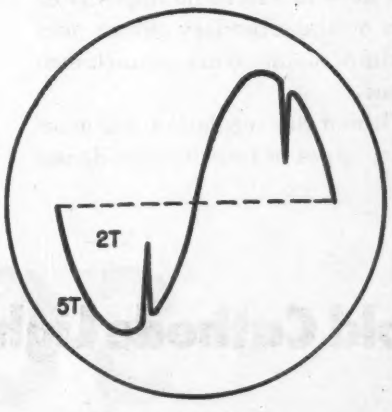

Fig. 13—A-C Sine Wave and Peak Voltage

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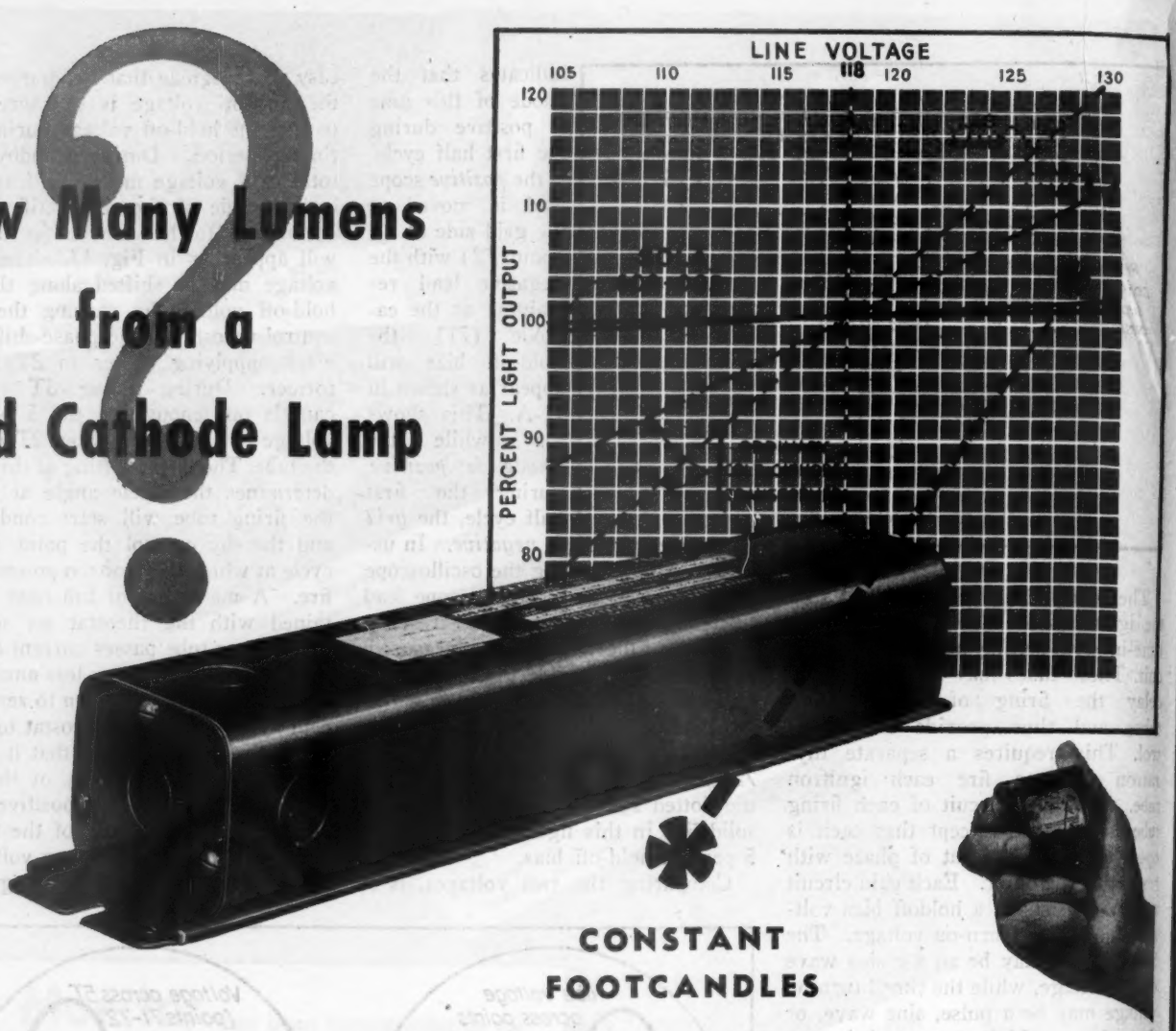

To produce rated lumens, a fluorescent lamp must be operated with the supply voltage at a constant 118 volts. So, if you know the lumen rating, and the lamp is powered by this new SOLA Cold Cathode Transformer, then you *know* the answer.

SOLA engineers have employed the famous SOLA Constant Voltage principle in the design of this transformer. Primary voltage variations as great at ±10% have no appreciable effect on the secondary output, and the lamps maintain maximum lumen output.

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will not conduct. Failure of hold-off bias 5T will result in both firing tubes conducting continuously. A defective peaking transformer 2T will result in failure of the firing tubes to conduct when a timing turn-on voltage is supplied by 3T. The heat control action may be checked by measuring the voltage drop across the firing tubes. This is accomplished by placing the positive scope lead on the anode and the negative lead on the cathode of the same tube. At 100 percent heat setting the voltage should appear as the solid line in Fig. 14 while at a reduced heat (approx. 50 percent) as shown in Fig.

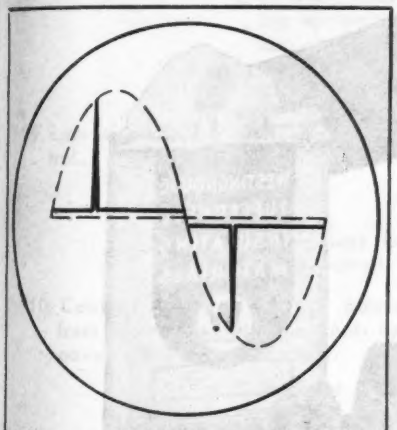

Fig. 14—Voltage Drop During 100 Per Cent Conduction *(Full heat)*

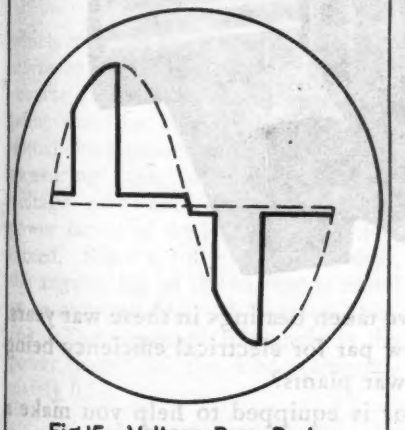

Fig. 15—Voltage Drop During Partial Conduction *(Low heat)*

15. The dotted sine wave is that voltage which appears across the tube during standby.

By examining the voltage between the anode and the cathode of a tube passing welding current, it is possible to measure the phase angle of the load current, determine the arc-drop of the tube, and determine that portion of the cycle during which conduction takes place. Referring to Fig. 16, the dashed line represents the anode voltage of two tubes, A and B, connected in inverse parallel. The solid line represents the arc voltage which is viewed during 100 percent conduction. The point at

SERVICE CHART
for Electronic Spot Welding Control Panel

INDICATION OF TROUBLE	POSSIBLE CAUSE	TESTS
1. No tubes fire when starting or initiating switch is closed.	a. Faulty circuit.	Check wiring of starting circuit with bell set or ohmmeter.
	b. Faulty relay (if used).	Check relay contacts. Keep all tip surfaces clean. Be sure relay operates when starting switch is closed.
	c. Faulty starting tube.	Replace tube with one known to be good.
	d. Cathode protection relay not timed out.	Check contact of relay. Be sure circuit closes after heating period.
2. Only starting tube operates when panel is initiated.	a. Faulty timing tube.	Replace tube with one known to be good.
	b. Faulty component part in timing circuit.	Check timing action with cathode-ray oscilloscope. Check resistors and capacitors in timing circuit with ohmmeter and capacity bridge.
3. Only starting, timing, and trailing tubes conduct.	a. Faulty protective relay in firing circuit.	Check relay contacts. Be sure relay is energized.
	b. Protective relay not energized.	Be sure water is flowing in power tubes and that flow switch contact is closed. Check safety and protective switches or any devices which might directly prevent relay from operating.
	c. Blown fuses in Ignitor firing circuit.	Replace fuses. Be sure Ignitron power tubes are in good condition. Load current must be at least 40 amperes.
	d. No timing voltage in grid circuit of firing tubes.	Check all firing tube grid voltages with cathode-ray oscilloscope. Determine if turn-on transformer is faulty.
4. Timing, trailing, and firing tubes conduct continuously.	a. Failure of d-c supply.	Check a-c and d-c voltages with voltmeter. Check fuses in d-c circuit. Replace rectifier tube with one known to be good. Check filter capacitors.
	b. Faulty resistor or capacitor in timing circuit.	Check 2b.
5. All tubes function except one firing tube and its corresponding ignitron.	a. Ignitor fuse blown.	Replace fuse.
	b. Improper setting of full heat limit resistor.	Too much resistance shorted out of full heat limit resistor. With cathode-ray oscilloscope, determine if 100 per cent heat occurs at some lower dial setting. Increase resistance so that full heat will occur at 100 per cent dial setting.
6. One firing tube conducts continuously.	a. Faulty tube.	Replace with tube known to be good.
	b. Loss of hold-off bias.	With cathode-ray oscilloscope connected from grid to cathode, determine if tube has proper hold-off grid bias.

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INDICATION OF TROUBLE	POSSIBLE CAUSE	TESTS
7. Trailing tube and corresponding firing and ignitron tubes conduct continuously.	a. Faulty trailing tube.	Replace with known good tube.
	b. No hold-off grid bias on trailing tube.	Check hold-off bias voltage with voltmeter.
8. Erratic timing.	a. Faulty timing tube.	Replace timing tube with one known to be good.
	b. Defective timing resistor or capacitor.	First check any variable resistors with ohmmeter. Then check other resistors and capacitors in timing circuit.
	c. Initiating circuit opening up before control has completed timing interval.	Instruct operator not to release initiating circuit until weld is completed. If cam-operated, adjust cam so as to maintain closed circuit during timing interval.
9. Loss of heat control.	a. Open heat control rheostat.	Disconnect rheostat and measure resistance with an ohmmeter. Check all other resistors in series with heat control.
	b. No voltage from heat control circuit.	Check action of heat control voltage in grid circuit of firing tubes.
10. Control power fuses blow when power is applied.	a. Control power transformer not connected properly.	Check primary connections to transformer. Refer to panel wiring diagram.
	b. Defective transformer in control.	Determine if any transformers connected in secondary circuit of control transformer are burned or shorted.

which one tube goes out and the other starts to conduct is represented by a reverse in arc voltage. It is at this point that the current (indicated by dotted line) passes through zero. By measuring the difference between voltage zero and current zero, the power factor of the load may be determined. Since a full cycle is 360 deg., the angular lag of the current is found to be approximately 60 degrees (Fig. 16). The cosine of this angle is the power factor of the load (approximately 0.5).

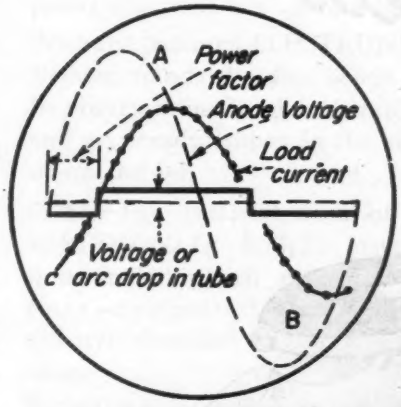


Fig. 16—Voltage Across Tubes During 100% Conduction to a Welding Load

Servicing

It is important to have the proper instruments available at all times if prompt repairs are to be made to electronic welding controls. A cathode-ray oscilloscope, volt-ohmmeter, tube tester, miscellaneous spare parts, and tools may be kept on a small cart similar to that shown in Fig. 1. In case of trouble, the cart can be easily wheeled to the machine requiring service and used conveniently where it is needed.

The ability of the serviceman to localize trouble will greatly reduce the servicing time during breakdowns. By segregating and studying the various individual circuits, the serviceman can gain a practical understanding of all the electronic welding control circuits in his care. While the service chart appearing in this article is for a control employing the circuits already discussed (Figs. 2 and 3), it provides the fundamental pattern to follow in approaching servicing problems of similar circuits in any type of electronic equipment.

Part IV of this welder control series will give extensive treatment to the somewhat more complicated timing circuits required in seam welding control.

Automatic Switching of Capacitors

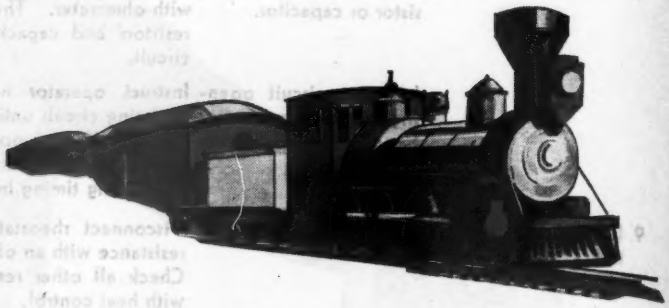
[FROM PAGE 74]

ing to or from 42 percent to 59 percent capacitor correction when it is necessary to pick up 58 percent and drop 42 percent or vice versa. This unevenness in switching steps is objectionable in some cases especially where it is desired to keep voltage disturbances down to a minimum. On the other hand there are other cases where this unevenness is not objectionable and may be used to advantage to keep the costs down to a minimum.

In a few cases it has been found desirable to switch capacitors off the line during light load conditions when they are not required because of objectionable harmonic currents flowing. These cases are rare and when they do occur it may be found more economical to switch the capacitor automatically than to apply a filter or wave trap to prevent the flow of these objectionable harmonic currents.

A study of plant load conditions and power requirements may indicate that some of the capacitors should be automatically switched during light load conditions even though consideration is given to economical possibility of placing some of the capacitors out at the motor terminals to be switched "off" and "on" with the motor. It will be noted from the above discussion that one of the three control schemes for automatic switching of capacitors can be selected to meet the desired requirements whether it is desirable to improve load voltage, improve plant power factor or reduce kva. demand and losses.

INDUSTRY PROBLEMS on the west coast are related by director T. L. Rosenberg (left), Oakland, Calif. (Region 14) as new NISA president Wm. H. Braunlich, Pittsburgh, Pa., listens intently at recent Directors session in Chicago.



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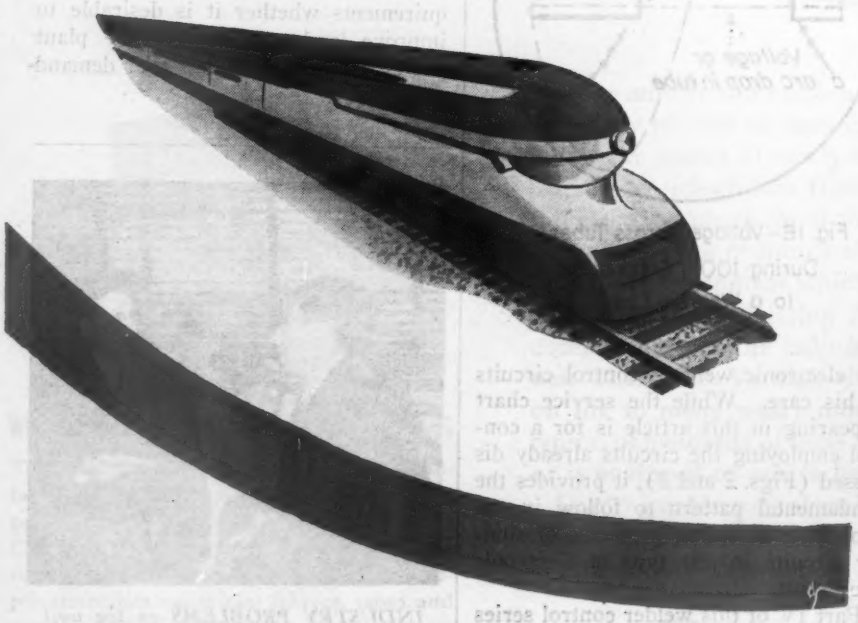

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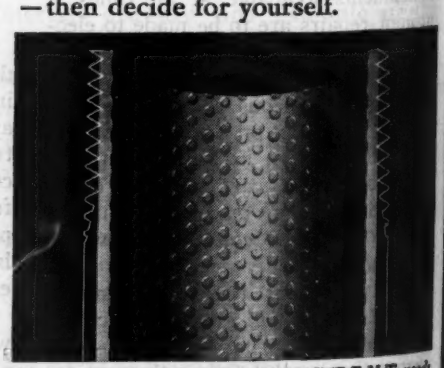

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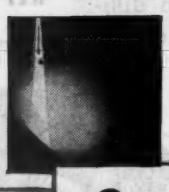

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Paralleling D-C Generators—I

Step-by-step procedure for paralleling shunt wound machines is outlined in this first article. Check list of inspections of individual machines prior to paralleling is also discussed.

By H. B. Black,
Manager, Contract Department,
Large Apparatus & Propulsion Section,
Crocker-Wheeler Electric Mfg. Co.
Ampere, New Jersey

DIRECT current is used extensively in numerous isolated power plants throughout the country, such as in large office buildings, hotels, state institutions, department stores, mines, industrial plants requiring wide-speed-range motor drives, for electrolytic process work, battery charging, etc., and it is also widely used in marine installations.

The d-c generators, as used in such installations, are driven by a wide variety of prime movers which frequently have widely different speed and torque characteristics, such as low-speed reciprocating steam engines, high-speed geared steam turbines, both high- and low-speed Diesel engines, gasoline engines, gas engines, etc. Frequently they are furnished as a part of a motor-generator set, in which case they are driven by either induction or synchronous motors that likewise have very different characteristics.

Parallel Operation Has Many Advantages

It is usual practice to install two or more generating units in a given plant and to operate only the required number of units in parallel as would be required to handle the existing load, plus expected overload swings. This practice affords greatest economy of operation combined with continuity of power supply, assures adequate generating capacity, provides stand-by equipment, and it also simplifies the matter of maintenance.

Successful parallel operation of two or more d-c generators is rarely something that "just happened"; it is invariably the result of numerous painstaking adjustments at the site. However, after these initial adjustments have been properly made, continued parallel operation becomes more or less automatic and operating procedure becomes but a simple matter.

Skill and Care Required

The nicety of parallel operation, or degree within which the paralleled units divide the load with either exact or proportional load division, (based on the respective generator ratings) *will depend entirely upon the skill and care used in making the initial paralleling adjustments* to the individual generating units.

The making of the necessary adjustments may require anywhere from an hour to several days, depending upon the number and types of the d-c generators involved, the types of the prime movers and their speed regulating governors, the station wiring, and also the availability of suitable loads to be used while machine adjustments are being made.

The purpose of this article is to assist those who are currently or who may become interested in making such initial adjustments. The required procedure becomes greatly simplified if one has a good understanding of the fundamental principles involved and then proceeds to satisfy all of the required conditions in the proper sequence. The degree to which the several required conditions are completely satisfied by proper adjustment, will determine whether the load ammeters will show stability and equal load division with coincident readings over the ammeter scale denoting good parallel operation; or the hogging of load by one generator, or wildly swinging ammeter readings often in opposite directions accompanied by circuit

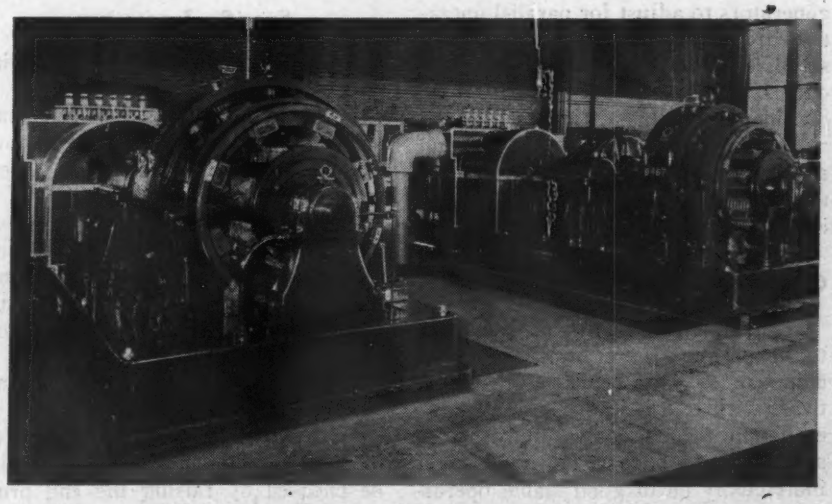

FIG. 1—Stabilized-shunt-wound machines are driven at high speed by geared steam turbines. These 750 kw. machines are paralleled to furnish the direct-current power requirements of the Louisville & Nashville R. R. shops in Louisville, Ky.

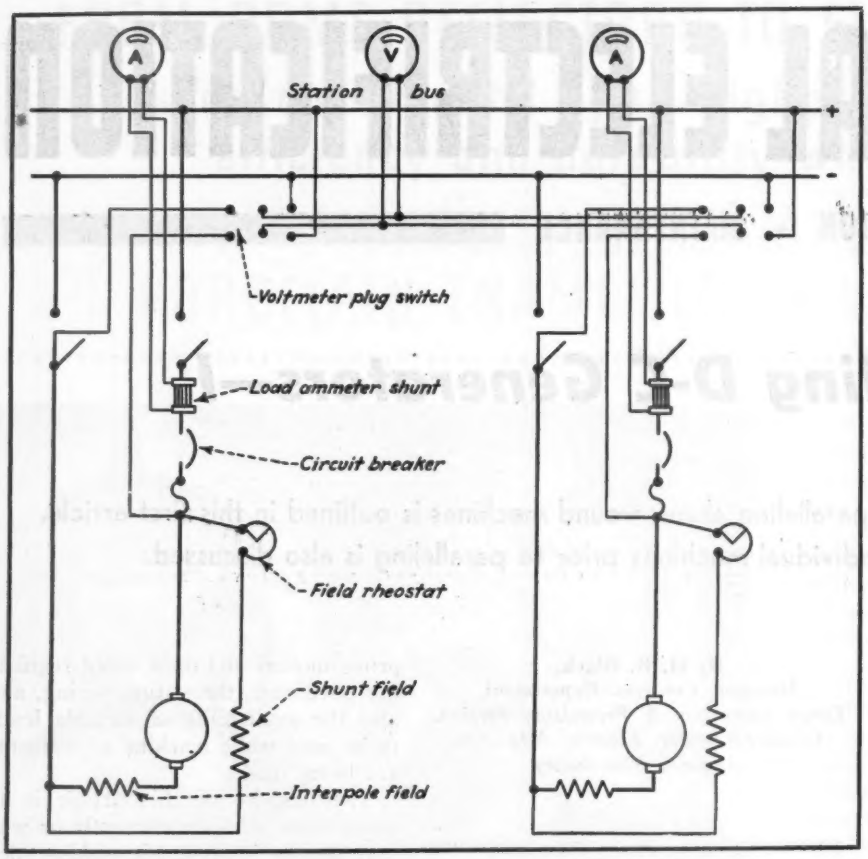

FIG. 2—Generator and switchboard connections for parallel operation of two plain shunt-wound interpole generators.

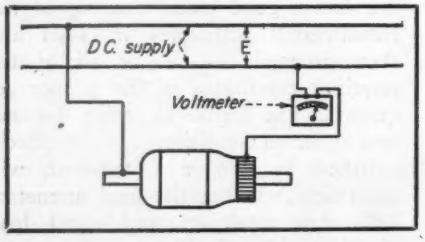

FIG. 3—Insulation resistance can be measured by use of a voltmeter connected in the above manner.

breakers continually tripping out.

The simplest and easiest types of d-c generators to adjust for parallel operation are the so-called plain shunt and stabilized shunt wound two-wire machines. Both of these types will be considered in this article, while the more complicated compound wound generators, compensated generators, three-wire generators will be covered in Part II to be published next month.

Careful Inspection of Individual Units

Irrespective of whether the machines to be paralleled are brand new machines or old ones being paralleled for the first time, it is in order to examine each unit throughout carefully before starting up to make certain that it will individually be in good stable operating condition; otherwise peculiar operating difficulties may be met later when two or more units are paralleled.

In many instances when the installation is being made (particularly in the larger ratings) it becomes necessary to partially dismantle a machine to facilitate handling. Sometimes parts that have been very carefully located and adjusted at the factory are unnecessarily removed and then inadvertently just "put back on"; the factory adjustment having been entirely "lost". Bolted connections are frequently not pulled up tight resulting in high resistance joints in what were intended to be very low resistance circuits, etc.

Specific Inspections

It is suggested that the following points be carefully checked.

1—Adjust air gaps between main poles and armature core to be uniform at top, bottom, and at each side. Check from both ends of the generator.

2—See that all brushes work freely in the brushholders and that spring tension is approximately two pounds per square inch of brush contact surface and that all brush pigtail connections are tight.

3—Each set of brushes carried on a brushholder stud or bracket must be equidistantly spaced from the next set in both directions. This can readily be checked by raising the end brush on each arm and then wrapping one complete turn of paper tape around the commutator, carefully marking the point of overlap. Remove the tape, carefully measure the distance as found around the commutator circumference, and divide into the proper number of divisions. Then replace tape around commutator and adjust brush positions to coincide with the correct spacing marks on the tape. The proper brush angle should also be carefully adjusted. Brushes should then be sanded in.

4—Put a wrench on every bolted connection throughout the entire unit, paying particular attention to all heavy copper circuits as they carry high currents and *must* have low resistance joints.

5—See that brush yoke rocker ring is located at factory-marked neutral position.

6—Check lubricating system and make certain that the oil level is correct in each bearing housing; that oil rings are properly in place and free to turn; or if a forced lubricating system is used, that a continuous supply of clean oil is flowing to each bearing.

7—Remove all tools, nuts, washers, etc., from close proximity of machine.

8—If the machines in question are new units to be started up for the first time (or old units that have been out of service for some time), the insulation resistance of both armature and field circuits should be tested.

Insulation Resistance Test

Moisture in generators reduces their insulation resistance. If any moisture is present, the machines should be dried out before being put into service. In order to determine whether the machines have absorbed sufficient moisture to reduce the insulation resistance, the windings should be meggered or the following test should be made.

For this test a d-c voltmeter is required that has a full-scale reading of not less than the d-c supply voltage used. (Meters should preferably be 250 volts or higher.) It is to be connected as shown in Fig. 3.

The voltmeter is first connected directly across the supply lines and the reading noted; it is then connected across the supply in series with the armature or other windings whose insulation resistance is to be measured (as shown in Fig. 3) and the reading noted. The value of the resistance X is given by the formula:

$$X = \frac{(E - Vr)\,Rv}{Vr}$$

where E is the reading of the voltmeter when connected directly across the supply, Vr is the reading of the voltmeter when connected in series with the resistance across the supply and Rv is the resistance of the voltmeter.

If the insulation resistance test shows that the resistance is low, the machine should be dried out by driving the armature at normal speed under a "controlled" short circuit (with open fields) for possibly several days. To do this, open the shunt and series field circuits and short circuit the armature by a cable which will carry two or three times the normal armature current, and which is also of sufficiently low resistance to constitute a "dead short circuit". When a machine of normal design is operated under such conditions, the residual magnetism will cause a current to flow in the armature, its value being somewhere between normal full-load current and twice that amount. An ammeter should be connected in series with the short-circuiting cable in order that the value of the short-circuit current may be observed. If the residual magnetism does not cause a sufficient current flow, the shunt field should be very weakly excited from some external source of low voltage. If severe sparking occurs at the commutator of a generator operating under these conditions, it may be reduced by shifting brushes forward.

Do not hurry the drying out process. If a machine is very wet and the drying out is forced by permitting too heavy a current to flow throughout the windings, steam may be formed between layers of insulation and the insulation may be punctured. It is preferable to start out with a current equivalent to half load for a one hour period, then to increase to ¾ load current for an hour, then full load current for an hour, etc. A record should be kept of the insulation resistance readings, and process continued until readings remain stationary for at least two hours.

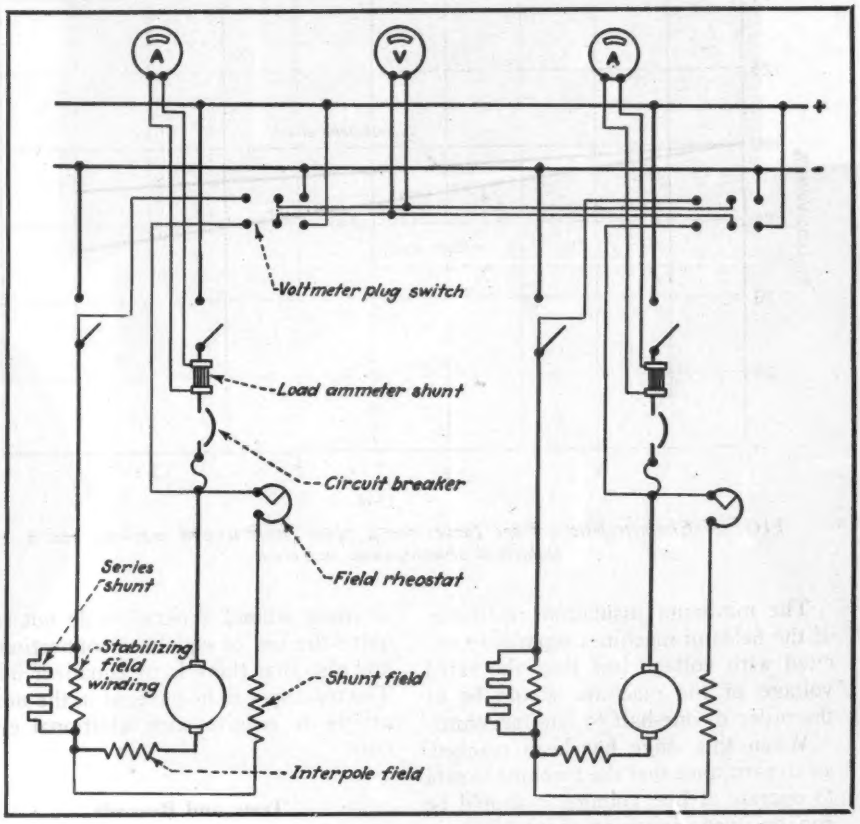

FIG. 4—Generator and switchboard connections for parallel operation of two stabilized-shunt-wound interpole generators.

The highest temperature in any part of the machine should not exceed 85 degrees C. The drying-out process should continue until the insulation resistance is of the order indicated in the American Standards for Rotating Electrical Machinery, No. C50, Appendix V, as follows:

$$\text{Insulation resistance in Megohms} = \frac{\text{Rated voltage of the machine}}{\frac{\text{Rating in kw}}{100} + 1000}$$

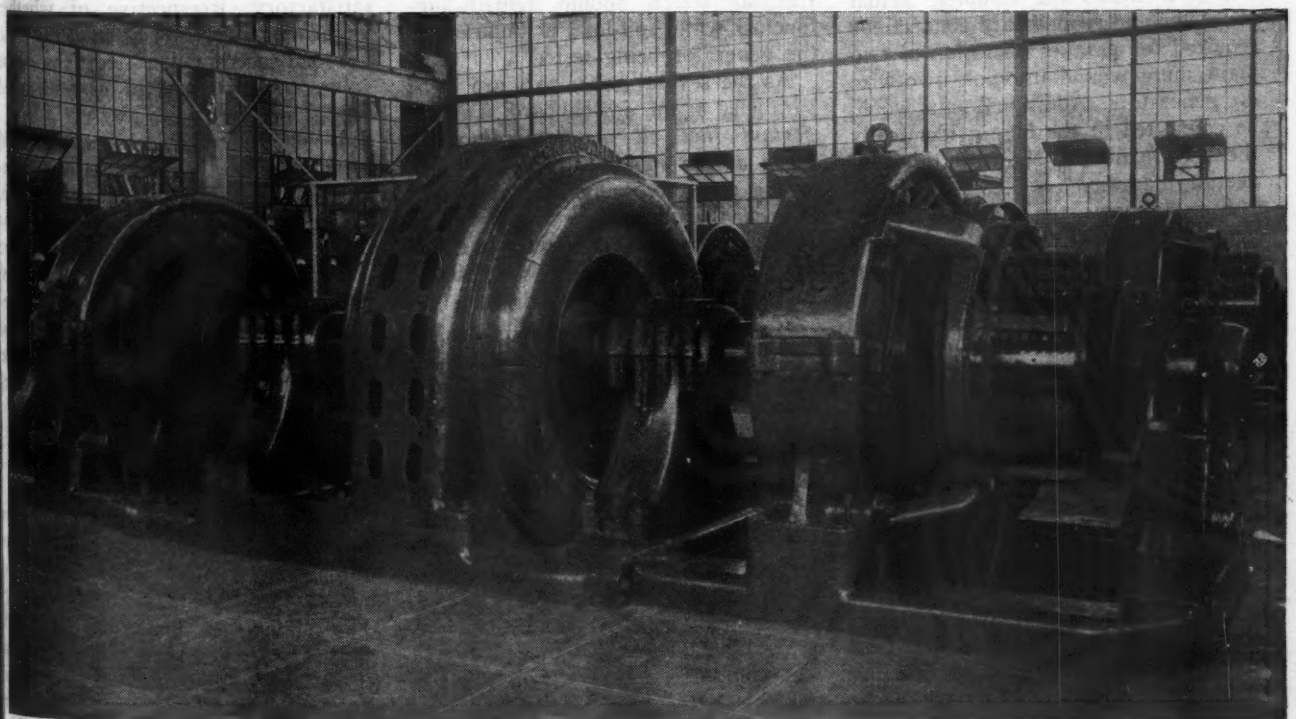

FIG. 5—Three triple-unit synchronous motor-generator sets operate in parallel in the Sharon Steel Hoop Company plant. Each generator is rated 1000 kw., 250 volt, 720 rpm. Prime-movers are 2800 kva., 2300 volt, 60 cycle machines.

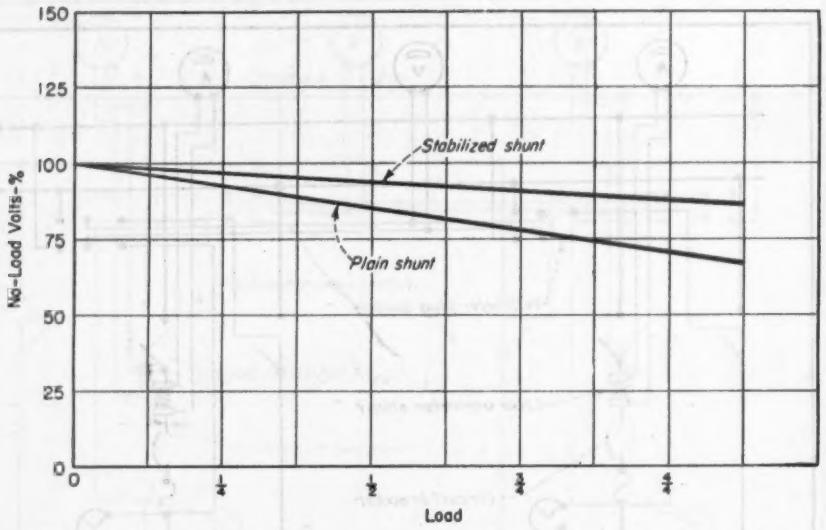

FIG. 6—Characteristic voltage curves for a plain shunt-wound machine and a stabilized shunt-wound machine.

The minimum insulation resistance of the fields of machines separately excited with voltage less than the rated voltage of the machine should be of the order of one-half to one megohm.

When this stage has been reached, as an assurance that the machine is safe to operate at line voltage, it should be run on open circuit at about 120 percent normal voltage for a short time before applying the load. Ordinarily, enough heat will be thrown off the rotating armature to dry out the field. In case this proves to be insufficient or in case only the field requires drying out heat may be applied to the field alone by connecting it to an external source of excitation with the machine at rest.

Fig. 2 shows the complete actual generator and switchboard connections required for parallel operation of two plain shunt wound interpole two-wire d-c generators. Additional units would be connected to the bus in identically the same manner as shown in this connection diagram.

Fig. 4 shows the complete actual generator and switchboard connections that are required for the parallel operation of two so-called stabilized shunt wound interpole two-wire d-c generators. A comparison of these connection diagrams, Fig. 2 and Fig. 4, will disclose that they are electrically alike, with the exception that the stabilized shunt wound generator is provided with an additional winding called the stabilizing field winding. It will be noted that this additional winding is connected in series with the interpole field and to the negative main. An adjustable series shunt is also connected directly across the stabilizing field terminals. The effect of the stabilizing field winding will be observed in the characteristic voltage curves of Fig. 6.

It will also be noted that both types of shunt wound generators do not require the use of equalizer connections, and also that there is no equalizer bus. The machines to be covered in the next article do require such additional circuits.

Tests and Records

Before attempting to operate two or more d-c generators in parallel, they should all first be individually tested and accurate records made of prime mover speed no-load, generator no-load voltage, prime mover speed full-load, generator full-load volts and amperes. The no-load voltages in each case will have first been adjusted to the rated voltage by means of the generator field rheostat which should remain untouched while full-load is imposed on the generator being tested.

As the several generators are to be paralleled at the switchboard, *it is important that all meter readings be taken at the switchboard* rather than at the respective generator terminals, in order that the voltage drop or loss in voltage in the cables between the several generators and the switchboard be included in the test readings.

It is from a comparison of these test readings (as obtained individually from the generating units to be paralleled) that one can intelligently determine what adjustments must be made, and to which generating unit or units. In short all units, should perform separately as nearly alike as is possible.

Fig. 4 shows the typical inherent voltage regulation curves of both plain shunt and stabilized shunt wound generators. It will be noted that both types have an inherent drooping voltage characteristic, or a falling off of voltage as the load is increased from no-load to full-load. The stabilizing winding as provided on stabilized shunt wound generators, is carried on the main poles, and consists of a very light (in percentage) series winding. Its function is to automatically strengthen the flux of the main shunt fields as the load is increased, thereby preventing the voltage from drooping as much as it otherwise would without benefit of such stabilizing effect.

Steps in Paralleling

The shape of the curve can readily be changed by adjusting the strength of the stabilizing winding as described later. A drooping characteristic is of considerable assistance in paralleling two or more generating units as it gives them an inherent tendency to share the load. Similar curves should be plotted for each unit to be paralleled. The steps to take in making paralleling adjustments are as follows:

1—Generator polarities should be checked and made to correspond to Fig. 2 and Fig. 4.

2. Prime mover governors should next be adjusted to give the same percent prime mover speed regulation, or change in prime mover speed from no-load to full-load on all units.

Although machines can readily be paralleled when their prime movers have flat speed regulation (same speed from no load to full load) it is generally considered preferable to adjust all the governors so as to give the prime movers a slightly drooping speed characteristic as the load is increased from no-load to full-load. About a two to three percent speed droop on each prime mover will be found to be satisfactory, irrespective of whether the prime movers are rated at the same full load speed or not. Note that these values are in terms of *percent* speed droop; not rpm.

3—The individual generators should be adjusted so that all units have identically the same voltage regulation. The no-load voltage is readily set by manipulation of the field rheostat. The rheostat should remain untouched while full-load is applied and the resulting voltage carefully noted. The resulting full-load voltage must be made alike on all units when starting from the same no-load voltage.

Adjusting Characteristic Curve

Stabilized shunt wound generators can readily be adjusted by means of the adjustable series shunt connected across the stabilizing field winding. The shunts, as generally furnished, consist of either cast iron grids or else strips of resistance metal connected in parallel with each other and then connected directly across the stabilizing field terminals.

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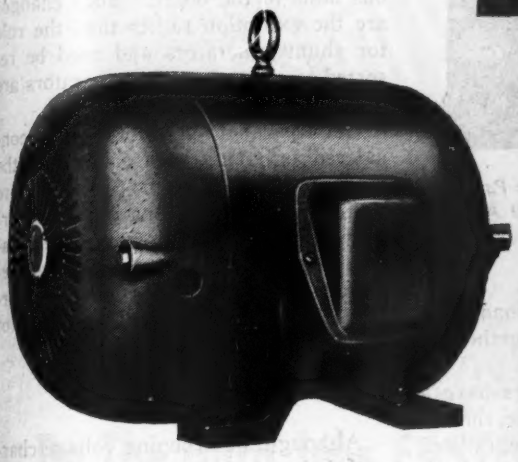

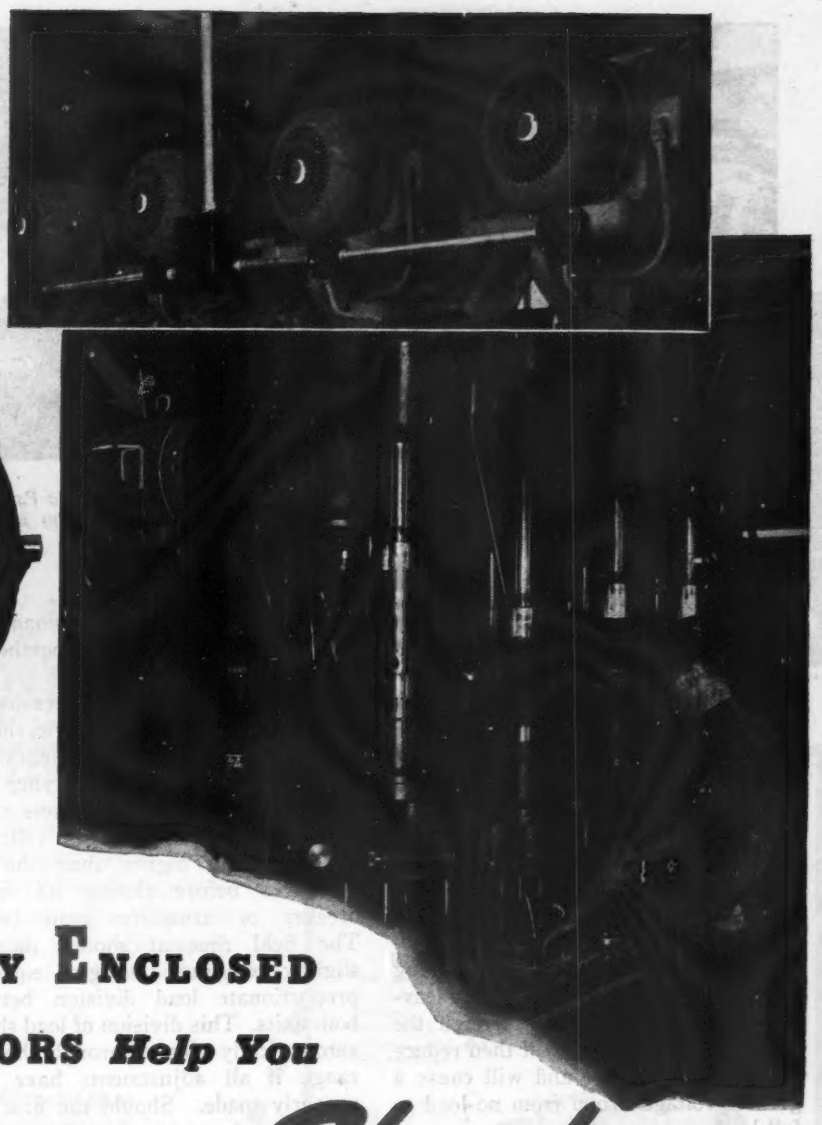

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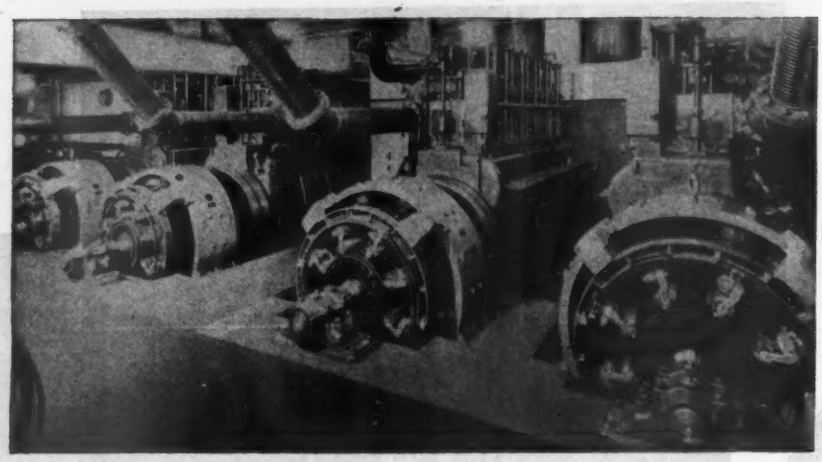

FIG. 7—These four Crocker-Wheeler machines serve the requirements of a Park Avenue apartment-hotel in New York City. Each machine is rated 300 kw. at 327 rpm., and is driven by a Worthington diesel.

The adjustable shunt is actually a by-pass for part of the current to go around the stabilizing field winding instead of through it. The removal of shunt grids or strips will increase the resistance of the series shunt by-pass and cause more current to flow through the stabilizing field winding. This action will thereby increase the stabilizing effect, resulting in less voltage droop from no-load to full-load. Conversely the addition of shunts will have the opposite effect, that is, it will decrease the by-pass resistance taking more of the series current thereby leaving less current flowing through the stabilizing field. This will then reduce the stabilizing effect and will cause a greater voltage droop from no-load to full-load.

It is to be noted that the overall voltage regulation of each generating unit as measured at the board, is actually the resultant of a combination of prime mover speed regulation, inherent generator voltage regulation, together with voltage drop in the cables to the switchboard.

The voltage regulation of shunt wound generators can also be changed slightly by shifting the brush position away from the factory-marked neutral position. Moving the brush rigging against rotation will decrease the voltage droop from no load to full load, while moving the brush rigging with rotation will increase the voltage droop from no-load to full-load. Moving the brush position away from the factory neutral setting should only be used as a last resort as such practice is an invitation to poor commutation if the brush rigging is moved too far in either direction. It should be done only in emergency circumstances; other adjustments as above are preferable.

4—After all generating units have individually been adjusted to have exactly the same no-load voltage and to also have exactly alike full-load voltage, two units can be put together on the board.

As shunt wound generators have a drooping voltage characteristic, the no-load voltage of the unit to be paralleled with one that is already carrying load, should be adjusted (by means of its field rheostat) so that its voltmeter reads slightly higher than the bus voltmeter before closing its circuit breaker or armature main switch. The field rheostat should then be slightly re-adjusted to give equal or proportionate load division between both units. This division of load should automatically obtain through the load range if all adjustments have been properly made. Should the first unit have a tendency to take on more than its proper share of load, its voltage output should be slightly decreased; or else the second unit should be readjusted to have a slightly higher voltage output so that the first will take only its proper share of load.

In general, shunt wound generators are comparatively easy to parallel and it is infrequent that any more complicated adjustments need be made other than those outlined above.

The ease with which shunt machines parallel is inherent because of their drooping voltage characteristic and can be explained from Fig. 6. Suppose two plain shunt machines are operating on similar regulation curves to that shown. As the first machine begins to hog the load because of its slightly higher voltage, the second is relieved of load in the same amount (assuming constant total load). Fig. 6 shows that as the load increases, the voltage decreases; and vice-versa, as the load decreases, the voltage increases. Therefore, as No. 1 machine's load increases, its voltage drops below that of No. 2 machine, and No. 2 then begins to grab the load. So it goes until the two finally settle down to equal voltage output and equal sharing of the load (providing initial adjustments have been properly made).

In very rare instances it may be necessary to change the generator air gap adjustments by changing the number of shims between the pole pieces and the frame, or to adjust the resistance of the cables connecting the various units to the board. Such changes are the exception rather than the rule for shunt generators and need be resorted to only when the generators are of widely dissimilar designs.

Good parallel operation can be considered as having been obtained if the load division between two or more units stays within a margin of 5 percent over the scale; however specifications concerning acceptance tests frequently permit a differential of 15 percent and in some cases 20 percent of the generator ampere rating.

Automatic Regulators

Although the drooping voltage characteristic of shunt wound generators is of assistance in paralleling such machines, from the standpoint of power and lighting service, it is undesirable and would require continual manual adjustment of the field rheostats to maintain a steady voltage on fluctuating loads. To overcome this objection, automatic voltage regulators are invariably used in connection with shunt wound machines. The intended use of automatic voltage regulators, however, does not preclude nor obviate the necessity of first making proper paralleling adjustments for manual operation.

To shut down a generator that is operating in parallel with others, proceed as follows:

1—Gradually cut more resistance into the shunt field circuit by means of the field rheostat until the load being carried by the unit to be removed is near zero.

2—Trip the circuit breaker.

3—Open all main switches.

4—Shut down prime mover.

Although the foregoing has to do with parallel operation of rotating machines only, it is of passing interest to note that rectifiers are frequently used to convert a-c to d-c. It is possible to parallel d-c generators with rectifiers and the requirements are somewhat similar to those of paralleling two rotating machines.

It will be necessary however to carefully select equipment having suitable means of adjustment by which both units can be made to have similar voltage regulation curves from no load to full load and/or automatic voltage regulating equipment.

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DATA SHEET

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S-1

NEMA Standard Terminal Markings and Connections—I

All symbols used on wiring diagrams to represent contactors, relays, limit switches, master switches and the like should be designated in accordance with the following tabulation.

These designations have been adopted by NEMA and should be used without exception wherever they apply. Additional designations when necessary should never consist of the same letter or letters already assigned in the tabulation except when there is no possibility of conflict in interpretation. For example "LS" is used for "Low Speed" and also "Limit Switch". However, "L" has been assigned to "Lowering" and should not be used for "Leveling" because "Leveling" and "Lowering" are closely associated on certain panels such as elevator panels.

A number used as a prefix may indicate a sequence or the use of more than one device for similar functions. For example 1A, 2A, 3A, indicate the first, second and third accelerating contactors while 1FL, 2FL, would indicate the use of more than one field failure relay. Numbers used as suffixes indicate terminals. A1, A2, L1, L2 are terminal designations.

The adopted standards for motor terminal designations and for switch gear devices are to be used on control diagrams.

STANDARD MARKINGS FOR CONTACTORS AND RELAYS

Armature Accelerating Contactor	A	1A,	2A,	3A
Armature Shunt Contactor	AS	1AS,	2AS,	3AS
Auxiliary Switch (Breaker) Normally Open "a"				
Auxiliary Switch (Breaker) Normally Closed—"b"				
Balanced Voltage	BV			
Brake	BR	1BR,	2BR,	3BR
Clutches	CL	1CL,	2CL,	3CL
Compensator Running Contactor	MR			
Compensator Starting Contactor	MS			
Condenser	J	1J,	2J,	3J
Control Relay	CR	1CR,	2CR,	3CR
Door Switch	DS	1DS,	2DS,	3DS
Down Contactor or Relay	D	1D,	2D,	3D
Dynamic Braking Contactor	DB	1DB,	2DB,	3DB
Field Accelerating Contactor or Relay	FA	1FA,	2FA,	3FA
Field Decelerating Contactor or Relay	FD	1FD,	2FD,	3FD
Field Discharge	FD			
Field Dynamic Braking Contactor	DF	1DF,	2DF,	3DF
Field Failure Relay or Contactor	FL	1FL,	2FL,	3FL
Field Forcing Relay or Contactor (Decreasing on Variable Voltage)	DF	1DF,	2DF,	3DF
Field Forcing Relay or Contactor (Increasing on Variable Voltage)	CF	1CF,	2CF,	3CF
Field Protective Relay (Field Weakened at Standstill)	FP	1FP,	2FP,	3FP
Field Reversing Relay or Contactor	FR	1FR,	2FR,	3FR
Field Weakening Relay or Contactor	FW	1FW,	2FW,	3FW
Final Limit Switch—Forward	FLF	1FLF,	2FLF,	3FLF
Final Limit Switch—Reverse	FLR	1FLR,	2FLR,	3FLR
Final Limit Switch—Hoist	FLH	1FLH,	2FLH,	3FLH
Final Limit Switch—Lower	FLL	1FLL,	2FLL,	3FLL
Final Limit Switch—Up	FLU	1FLU,	2FLU,	3FLU
Final Limit Switch—Down	FLD	1FLD,	2FLD,	3FLD
Forward Relay or Contactor	F	1F,	2F,	3F
Full Field Relay or Contactor	FF			
Generator Field Relay or Contactor	GF			
High Speed Contactor or Relay	HS			
Hoist Contactor or Relay	H	1H,	2H	
Jam Contactor or Relay	J			
Kickoff Contactor or Relay	KO			
Landing Contactor or Relay	LD	1LD,	2LD,	3LD
Limit Switch	LS			
Lowering Contactor or Relay	L	1L,	2L,	3L
Low Speed Contactor or Relay	LS	1LS,	2LS,	3LS
Low Torque Contactor or Relay	LT			
Low Voltage Contactor or Relay	LV			
Magnets	M	1M,	2M,	3M
Master Switch	MS			
Maximum Torque Contactor or Relay	MT			
Middle Landing Contactor or Relay	MLD			
Main or Line Contactor	M	1M,	2M,	3M
Motor Field Contactor or Relay	MF	1MF,	2MF,	3MF
Overload Relay	OL	1OL,	2OL,	3OL
Pilot Motor	PM	1PM	2PM,	3PM
Plugging Contactor or Relay	P			
Reverse Contactor or Relay	R	1R,	2R,	3R
Solenoids	S	1S,	2S,	3S
Series Relay	SR	1SR,	2SR,	3SR
Slow Down Relay or Contactor	SD			
Separator Pulleys	M	1M,	2M,	3M
Thermostat	TS	1TS,	2TS,	3TS
Time Relay	T	1T,	2T,	3T
Up Contactor or Relay	U	1U,	2U,	3U
Undervoltage Relay	UV	1UV,	2UV,	3UV
Voltage Relay	VR	1VR,	2VR,	3VR

When one or more controllers are used with 2 or more motors, use contactor and relay markings as below whenever possible. Use other markings only when required by special conditions.

	Motor No. 1	Motor No. 2	Motor No. 3
Forward Contactors	11F–12F	21F–22F	31F–32F
Reverse Contactors	11R–12R	21R–22R	31R–32R
Main Contactors	11M–12M	21M–22M	31M–32M
Dynamic Contactors	11DB	21DB	31DB
Accelerating Contactors	11A–12A–13A	21A–22A–23A	31A–32A–33A
Field Accelerating Relay	11FA–12FA	21FA–22FA	31FA–32FA
Field Failure Relay	11FL–12FL	21FL–22FL	31FL–32FL
Dynamic Field Relay	11DF	21DF	31DF
Overload Relay	11OL–12OL	21OL–22OL	31OL–32OL

For other contactor and relay markings listed on ML1757—8 and 9, or for more than 3 motors, apply prefixes in a similar manner.

TERMINAL MARKINGS

When one or more controllers are used with 2 or more motors, use terminal markings as below whenever possible. Use other markings only when required by special conditions.

For more than 3 motors, apply prefixes in a similar manner.

	Motor No. 1	Motor No. 2	Motor No. 3
Armature	1A1–1A2	2A1–2A2	3A1–3A2
Series Field	1S1–1S2	2S1–2S2	3S1–3S2
Shunt Field	1F1–1F2	2F1–2F2	3F1–3F2
Brake	1B1–1B2	2B1–2B2	3B1–3B2
Stator	1T1–1T2–1T3	2T1–2T2–2T3	3T1–3T2–3T3
Rotor	1M1–1M2–1M3	2M1–2M2–2M3	3M1–3M2–3M3
Control Terminals	10 to 19 incl.	20 to 29 incl.	30 to 39 incl.
Resistor Terminals	1R1–1R2–1R3 1R11–1R12–1R13 1R21–1R22–1R23	2R1–2R2–2R3 2R11–2R12–2R13 2R21–2R22–2R23	3R1–3R2–3R3 3R11–3R12–3R13 3R21–3R22–3R23

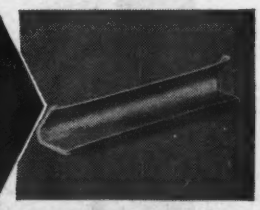
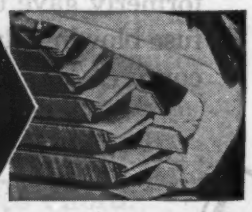
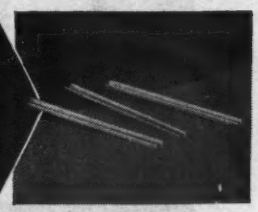
Information from Cutler-Hammer, Inc.

Thorough Insulation of Windings keeps Wagner Motors on the job!

THE windings of Wagner motors are thoroughly insulated with liberal quantities of the highest-quality materials. Wagner engineers will not permit the use of insulation which is barely adequate for ordinary service. They insist that all windings shall be thoroughly insulated so that Wagner motors will render dependable service even under the most severe operating conditions.

Illustrated and described below are a few of the reasons why the insulation on Wagner polyphase stator windings of the diamond type virtually precludes the possibility of failure.

POSSIBLE CAUSE OF GROUND	WAGNER INSURANCE AGAINST GROUND	POSSIBLE CAUSE OF SHORT CIRCUIT	WAGNER INSURANCE AGAINST SHORT CIRCUIT
Slot cell cut by core iron.	Smooth core and slots.	Contact between turns in coils.	Heavy coating of synthetic varnish on wire.
Slot cell torn during winding.	One piece, tough, cuffed slot cell.	Contact between coils in slot.	Heavy, tough separator in slot.
Creepage through mouth of slot.	Inverted cell over coil.	Contact between ends of coils.	Varnished-muslin phase-sheets.
Creepage caused by dirt on winding.	Coils completely taped and varnish-treated.	Contact between coil connections.	Varnished-muslin insulating-tubes.

29 BRANCH OFFICES

Wagner maintains 29 branch offices located in principal cities. Each office is manned by trained field engineers who will gladly consult with you.

M 45-5

Wagner

ELECTRIC CORPORATION

6413 Plymouth Avenue, St. Louis 14, Mo., U. S. A.

ELECTRICAL AND AUTOMOTIVE PRODUCTS

OTHER WAGNER PRODUCTS

Write for literature on Wagner Motors, Transformers, and Industrial Hydraulic Braking Systems.

"We Put An End To Electrical Shutdowns On Our Compressor Circuits By Standardizing On BUSS Super-Lag Fuses"

—S. S. "Jerry" HOGATT, *Chief Electrician*
JACKSON BREWING CO. • NEW ORLEANS

Bernard L. Kiernan, Chief Engineer, checking operation charts in his office.

Mr. Bernard L. Kiernan, Chief Engineer of Jackson, the largest brewery in the South, amplifies Mr. Hogatt's statement with these added facts—"Our compressors and pumps formerly gave us constant trouble. Frequent fuse blowing, due to the heavy load when the compressors started, caused many shutdowns. We couldn't afford the costly experience of having our equipment out of service when we needed all the production we could get. We eliminated that problem, though, when we standardized on BUSS Super-Lag fuses. They have helped us save a lot of time, annoyance, and expense—and helped keep production up, too."

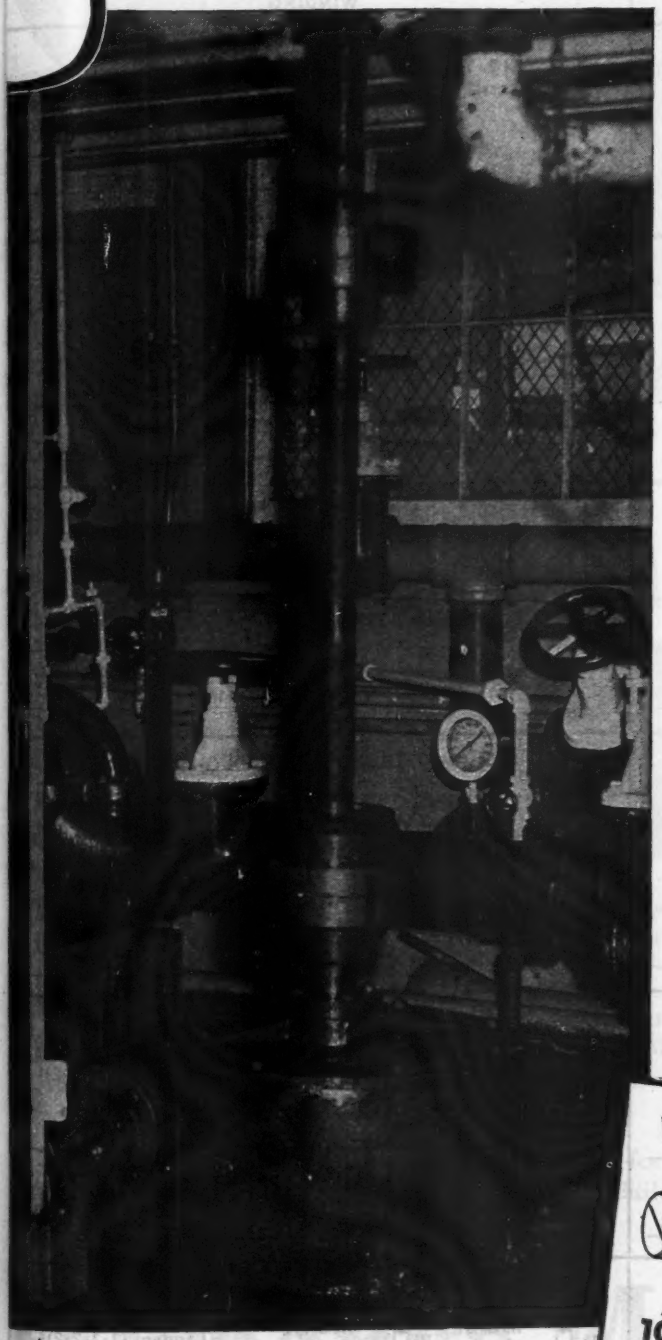
S. S. "Jerry" Hogatt, Chief Electrician, on inspection tour in his spotlessly clean plant.

BUSS *Super-Lag*

SOLD THROUGH WHOLESALERS

Why BUSS Fuses greatly reduce or entirely prevent needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.



The fuse link used is the famous "BUSS Super-Lag". It has lag-plates attached to it. These give it a time-lag so long that it will reduce to an extent not possible with any other renewable fuse, the number of shutdowns caused by needless fuse blows.

Prevent future trouble in your plant—by doing this today

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the care-free, trouble-proof protection that BUSS Super-Lag fuses afford.

BUSSMANN MANUFACTURING CO.
St. Louis 7, Mo.
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FUSES

Why BUSS Fuses Don't Blow Needlessly

10 FEATURES in the design of the FUSE-CASE help make it possible

and

***The* SUPER-LAG** development in the FUSE-LINK completes the job.

DATA SHEET

The number at the right is a classification for convenience in filling and for a future data sheet index

S-2

NEMA Standard Terminal Markings and Connections—II

For Multispeed Separate and Reconnected Winding Motors

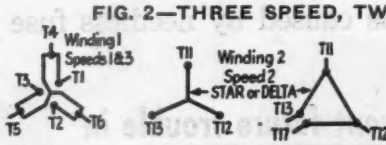
VARIABLE TORQUE, RECONNECTED WINDING

FIG. 1—TWO SPEED, SINGLE WINDING

Speed	Connect Lines L1 To Motor Terminals	L2 To Motor Terminals	L3 To Motor Terminals	Connect Together
1	T1	T2	T3	.....
2	T6	T4	T5	T1, T2, T3

Typical Speeds—600, 1200.

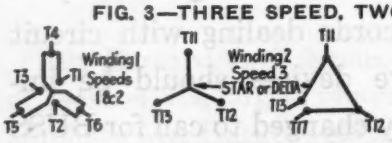
FIG. 2—THREE SPEED, TWO WINDING



Alternate (1-2-1) Arrangement. Typical Speeds 600, 900, 1200.

1	T1	T2	T3	.....
2	T11	T12	T13, T17	.....
3	T6	T4	T5	T1, T2, T3

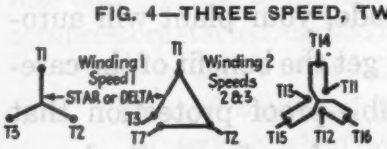
FIG. 3—THREE SPEED, TWO WINDING



Tandem (1-1-2) Arrangement. Typical Speeds 600, 1200, 1800.

1	T1	T2	T3	.....
2	T6	T4	T5	T1, T2, T3
3	T11	T12	T13, T17	.....

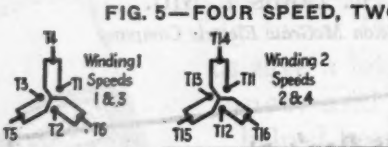
FIG. 4—THREE SPEED, TWO WINDING



Tandem (1-2-2) Arrangement. Typical Speeds 600, 900, 1800.

1	T1	T2	T3, T7	.....
2	T11	T12	T13	.....
3	T16	T14	T15	T11, T12, T13

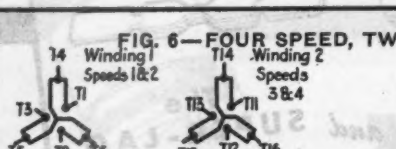
FIG. 5—FOUR SPEED, TWO WINDING



Alternate (1-2-1-2) Arrangement. Typical Speeds 600, 900, 1200, 1800.

1	T1	T2	T3	.....
2	T11	T12	T13	.....
3	T6	T4	T5	T1, T2, T3
4	T16	T14	T15	T11, T12, T13

FIG. 6—FOUR SPEED, TWO WINDING



Tandem (1-1-2-2) Arrangement. Typical Speeds 600, 1200, 1800, 3600.

1	T1	T2	T3	.....
2	T6	T4	T5	T1, T2, T3
3	T11	T12	T13	.....
4	T16	T14	T15	T11, T12, T13

Information from Cutler-Hammer, Inc.

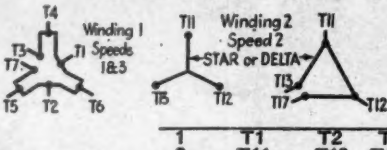
CONSTANT TORQUE, RECONNECTED WINDING

FIG. 7—TWO SPEED, SINGLE WINDING

Speed	Connect Lines L1 To Motor Terminals	L2 To Motor Terminals	L3 To Motor Terminals	Connect Together
1	T1	T2	T3	.....
2	T6	T4	T5	T1, T2, T3

Typical Speeds—600, 1200.

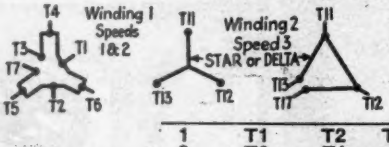
FIG. 8—THREE SPEED, TWO WINDING



Alternate (1-2-1) Arrangement. Typical Speeds 600, 900, 1200.

1	T1	T2	T3, T7	.....
2	T11	T12	T13, T17	.....
3	T6	T4	T5	T1, T2, T3, T7

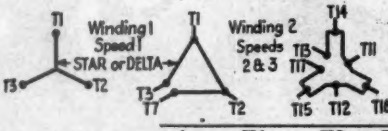
FIG. 9—THREE SPEED, TWO WINDING



Tandem (1-1-2) Arrangement. Typical Speeds 600, 1200, 1800.

1	T1	T2	T3, T7	.....
2	T6	T4	T5	T1, T2, T3, T7
3	T11	T12	T13, T17	.....

FIG. 10—THREE SPEED, TWO WINDING



Tandem (1-2-2) Arrangement. Typical Speeds 600, 900, 1800.

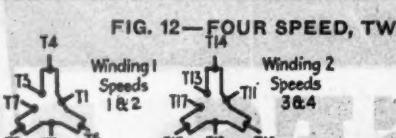
1	T1	T2	T3, T7	.....
2	T11	T12	T13, T17	.....
3	T16	T14	T15	T11, T12, T13, T17

FIG. 11—FOUR SPEED, TWO WINDING

Alternate (1-2-1-2) Arrangement. Typical Speeds 600, 900, 1200, 1800.

1	T1	T2	T3, T7	.....
2	T11	T12	T13, T17	.....
3	T6	T4	T5	T1, T2, T3, T7
4	T16	T14	T15	T11, T12, T13, T17

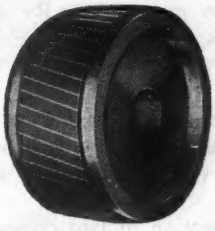
FIG. 12—FOUR SPEED, TWO WINDING



Tandem (1-1-2-2) Arrangement. Typical Speeds 600, 1200, 1800, 3600.

1	T1	T2	T3, T7	.....
2	T6	T4	T5	T1, T2, T3, T7
3	T11	T12	T13, T17	.....
4	T16	T14	T15	T11, T12, T13, T17

The Only Motor with a *Copperspun* ROTOR



Only in Fairbanks-Morse Motors will you find rotors centrifugally cast in *one piece*—and of *copper!*

The characteristics of copper make it the ideal rotor material. Copper has high electrical and thermal conductivity (twice as good as aluminum), greater strength, and low thermal expansion.

The indestructible copperspun rotor, with its better electrical characteristics, puts the new Fairbanks-Morse Motor far ahead of the times in stamina, in protection, and in versatility.

See a demonstration of what this motor can do for you. Write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

Every Good Feature You Could Ask!

Protected Frame—Excludes dripping liquids and falling particles.

Cross-flow Ventilation—Another exclusive feature. Air moves in both directions, providing uniform cooling—no hot spots.

Ball Bearings—Sealed in and protected.

Recessed Conduit Box—An innovation for neat installations in close quarters. Conventional box also provided.

Adaptability—Frame gives protection in any mounting position because the vented bearing brackets can be turned to four positions 90° apart. Reversible frame permits locating conduit box on either side.

Balanced Characteristics—A 40°C. motor with high efficiency and power factor, and excellent starting and accelerating torques.

BUY AND KEEP MORE WAR BONDS

Fairbanks-Morse

A name worth remembering

Diesel Locomotives • Diesel Engines • Generators • Motors • Pumps • Scales
Magnetos • Stokers • Railroad Motor Cars and Standpipes • Farm Equipment

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay $5.00.

READER'S QUIZ

COLD CATHODE TRANSFORMERS

QUESTION 176—We would like to replace a burned out neon tube transformer rated at 3500 volts, 15 ma. with another we have on hand rated at 7500 volts, 15 ma. Will this shorten the life of the tubes, or in any other way affect the operation of the sign?—J.J.L.

A. TO QUESTION 176—Neon tube transformers have drooping characteristics which will limit the voltage to a safe value.

However, you can always use a resistor in series with the low voltage side to get exact voltage.—H.S.

A. TO QUESTION176—A high voltage is needed to ionize the gas in a cold cathode type of neon tube but when the tube starts to conduct its resistance drops to a low value. Some means must then be used to limit the current. By proper design the transformer is made to hold the current at a constant value. The secondary voltage may then vary over wide limits but the current will remain fixed.

It is therefore feasible to use a 7500 volt transformer in place of the damaged 3500 volt unit provided that the current ratings are identical.

There will be no change in the operating characteristics of the neon tube as long as the current remains the same.

The large transformer may have somewhat greater losses and operate at a lower power factor. These effects, however, should be so small as to be practically negligible.—J.F.Y.

POLARITY REVERSED

QUESTION 177—A very sudden and heavy overload was placed on two of our over-compounded motor generator sets operating in parallel. The circuit breaker went out and the polarity of one generator reversed as indicated on the switchboard voltmeter. Why did the polarity reverse and how can the equipment be protected against a reversal of polarity? They are 50 kw. machines and the individual breakers are set at 200 amperes with the main breaker at 400 amperes.—L.A.

A. TO QUESTION 177—The fact that the polarity of one compound generator reversed indicates that the two generators did not have exactly the same characteristics. Apparently the voltage of one generator was appreciably higher than that of the other and this resulted in the current flowing in a reverse direction through the series field. This current must have been greater than normal and so resulted in overpowering the shunt field and reversing the polarity of the generator. By adjusting the shunts on the series fields of the two generators so as to give the same degree of over-compounding, the voltage of the generators will be the same at all loads and there will be no unbalanced voltage to cause a reverse current.

A connection of two compound d-c generators in parallel will operate satisfactorily if the generator characteristics are the same and a low resistance equalizer connection is provided. This will be a busbar or conductor of large current carrying capacity connected from the point at which one series field is connected to the generator armature, to the corresponding point in the other generator.—J.E.W.

A. TO QUESTION 177—Reversal of polarity is not alarming and takes place frequently, depending upon circumstances. Sometimes the instantaneous rush of current becomes so great that its effect in flowing through the series winding is to reverse the direction of the magnetic field, building up its voltage in the reverse direction. Initial decrease would cause a diminution of excitation which would further reduce the current, affecting the field strength. Such action will continue until one generator carries the entire load, and the other generator none. This process will continue until the "unloading" generator is running as a motor, receiving its current from the already fully loaded machine. That is, the unloaded generator is now taking current from the bus instead of delivering current to it.

As to how to prevent a repetition, relays could be installed to avoid motorizing of generator. For optimum operation, the generator itself should incorporate outside field excitation, either by means of exciter, (separate or common driven by motor of m-g set) or with a battery floating on a central exciter bus. However, considering the little benefit derived, either suggestion does not warrant the installation of additional equipment. Installing reverse polarity relays with which to avoid motorizing of generator should be sufficient. The balance of the trouble is of more or less minor importance.—R.F.N.

A. TO QUESTION 177—There are numerous ways of reversing the polarity on a self excited generator.

The only protection is a separate exciter, or at least an arrangement whereby you can feed d-c through the shunt field for 10 seconds each time before starting. A No. 6 dry cell should last a long time for this service. This must be connected according to standard practice.

After polarizing each machine start generator No. 1. Then proceed with standard parallel operation switching which is as follows. Place the series field of generator No. 2 in parallel with the series field of the No. 1 machine through the equalizer. Second, connect one side of field and armature to the series field. Connect the other side of the field and armature to the load.—H.S.

A. TO QUESTION 177—For satisfactory parallel operation of over-compounded generators, both machines should have the same voltage rating and the same percentage regulation; series field resistance should be inversely proportional to the current

rating of the respective generator; and there must be an equalizer connection to parallel the series fields of the two generators. Even when identical generators are used, the distance of each from the switchboard must be taken into consideration. Higher IR drop in the line of a more distant generator will cause it to take a lower load than its proper share. A resistor connected in series with the series of lower resistance will remedy this condition.

The cross-section of the equalizer must be at least one-third of that of the main leads so as to have low resistance. This connection must also be as short as possible. Where distances between switchboard and generators are greater than the distance between generators, the equalizer may be run directly between the two machines.

In the present case, it seems that the two generators are not dividing the load in proportion to their rating due to one of the foregoing reasons. Evidently, the very sudden and heavy overload caused the generator with the relatively lower resistance in the series field circuit to pick up all the load and run the other generator as a differential compound motor. The generator remaining on the line was sufficiently more overcompounded to cause the ampere-turns of the reversed current through the series field of the tripped generator to overpower its shunt excitation and air-gap flux. The reversed electromagnetic torque caused the series field of the generator with relatively higher resistance to attempt to drive its induction motor prime mover backward.

To protect this equipment against power disturbances and reversal of polarity, it is advisable to increase the resistance of the series field circuit with lower resistance so as to make their values inversely proportional to their ratings.

A solution might be found in the elimination of the series field windings and equalizer, thus operating the two generators as shunt-wound machines with drooping voltage regulation, provided they can be made to have identical droop characteristics. Then when a sudden and heavy overload occurs, the generator tending to take more than its share of the load will have a greater voltage drop and will allow the other machine to take its share of the load.

A compromise may be reached by flat compounding or lowering the degree of overcompounding of the two generators. This may be done by connecting suitable resistors across the series field of either or both generators, by-passing some of the series field excitation.—R.G.C.

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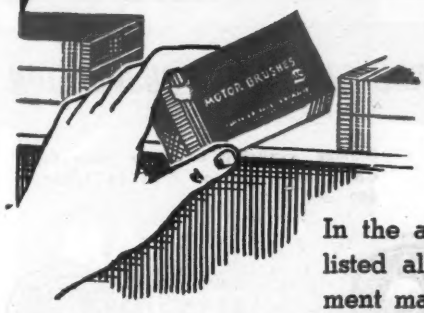

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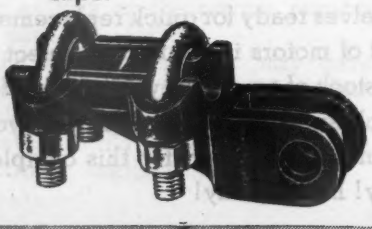

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TESTING SMALL MOTORS FOR SHORTED COILS

QUESTION 178—We are thinking seriously of specializing in fractional horsepower motor repair work. Since most repulsion-induction armatures are lap-wound with a cross-connected commutator, what is a quick and practical way to check such windings for coil to coil shorts? Conventional type growler and saw-blade test is very unsatisfactory and raising the top leads makes extra work.—H. G. H.

A. TO QUESTION 178—I have been testing armatures which are lap wound with cross connections for the past eight to ten years with the following method.

The operator or mechanic places a wattmeter (indicating type) in the line supplying the growler. The armature to be tested is placed on same with the wattmeter indicating the current flowing into the growler. As the armature is rotated the wattmeter will show an even deflection providing there are no shorts. In the event the armature is shorted, the wattmeter will show a greatly increased current or deflection. This method is very accurate and widely used.—J. R. W.

A. TO QUESTION 178—If the motor is assembled, with stator good, and bearings fair, the simplest way to check for shorts is to proceed as follows. Lift or remove the brushes from the commutator. In motors with short circuiting mechanism, remove, or otherwise make sure that no part of the short circuiting mechanism, or brush holder makes any contact with the commutator. In some cases, the quickest way is to remove the armature, remove the brushes and short circuiting mechanism, (which usually has to be done in any case), put the armature back in the stator, and replace the end housings. With this accomplished, apply current of rated voltage to the stator. If the rotor has no shorts, you should be able to turn the rotor freely, grasping the shaft. If the rotor is shorted, it will tend to pull or hang in certain definite spots, and will resist efforts to turn it by hand. This method of testing is very simple, and sure, and can be used in the field.

If the stator of the motor is not good, and only the rotor has been received, we can test as follows, using a growler. The growler is placed in a circuit with a wattmeter. If we place the rotor on the growler, and rotate slowly, and evenly, the reading on the wattmeter will not vary if we have no shorts. If we have one or more shorted coils, as

these coils come into the growler magnetic field, current will be generated in these shorted portions, increasing the load on the growler. This increase will show in the wattmeter readings. If we rotate the rotor to a position where we have the greatest reading, and hold it there, the current through the shorted coil or coils may be great enough that they can be located by the heat or smoke produced.

The wattmeter method can also be used by testing the rotor in its own stator, as first described. With the wattmeter in the stator circuit, if the rotor is good, there will be no variation of readings. If the rotor is bad, the readings will vary as the rotor is turned. The stator, without end housings, can be used in place of a growler, if no growler is available, or large enough. Or, any stator, of the same number of poles can be used, if the clearance between rotor and stator is not over $\frac{3}{32}$th or $\frac{1}{4}$ inch.

Having determined from any of the above methods whether the rotor is or is not shorted, we can proceed further. On small motors, many shops, if the rotor is shorted, do not spend any time trying to locate or remove shorts. They just rewind it. However, in many instances, the short may be of a minor nature, and easily found and removed, or it may be, as is the case in a great number of jobs, a short or bug in the commutator, after it has been turned on the lathe.

In locating shorts we use what might be called a high current test. It has a number of advantages. Sending several times normal current through the armature, not only locates shorts, but will show up opens due to poorly soldered connections that a millivolt test will not show, particularly on armatures with few turns of heavy wire per coil. It is easily and quickly used, and in cases of commutator bugs, due to copper chips from turning, will usually "blow" right out.

We use a transformer, with a six volt secondary, of about 200 watts capacity, and with the primary in series with a wattmeter. A short circuit in the secondary will give us from 100 to 125 amps., which explains how we "blow" out bugs in the commutator. With the wattmeter in the primary of the transformer, we test from bar to bar with two heavy leads and test prods from the secondary of the transformers.—H. D.

A. TO QUESTION 178—Armatures with cross-connected commutators can best be checked by means of "bar to bar" test. A source of d-c will be needed. If no regular d-c supply is available, then a dry cell battery may be used. The d-c is applied

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through a limiting resistance across one quarter of commutator. A bar to bar test is then made with a d-c milliameter. By observing the meter readings the following deductions can be made:

1. Uniform readings around the commutator indicates that the winding is OK.
2. A low reading, or no reading at one point, indicates a short in commutators or coil.
3. A high reading indicates an open coil or a loose commutator lead.—L. M. K.

A. TO QUESTION 178—Repulsion-induction armatures, lap-wound with cross connected commutators can be rapidly checked on the growler by using an 0/3 a-c panel type ammeter in the growler circuit and a 6 ohm, 25 watt rheostat. The rheostat can be used to obtain a suitable normal reading: low readings will then indicate shorts.—J. R.

A. TO QUESTION 178—In testing a repulsion-induction motor with a cross-connected commutator use a growler and headphones and test from bar to bar. If a coil is shorted there will be little or no buzz in the headphones. Another way is to remove brushes, holder and short circuiting device. Replace armature in frame and bolt together the end bells. Apply full voltage to stator winding and if armature locks in one position by magnetic pull then there are some shorted coils in the armature. The commutator should be checked carefully to make sure that any indicated shorts are not just shorted bars.—M. H. S.

REVERSED FIELD CONNECTIONS

Q *UESTION 179—We recently put a 3 hp., 250 volt d-c series-wound crane motor into service after rewinding the field poles. The motor seemed to operate satisfactorily with the exception of a bad sparking condition at one point on the commutator. After thoroughly checking the entire motor, we found that both poles (two-pole motor) were connected for the same polarity. Why did this motor run at all and why did it spark so badly at only one point?—F.L.*

A. TO QUESTION 179—Both field windings of the same polarity, the motor would start with a very weak field and extremely high armature current. The weak field

would be produced by the residual magnetism in the pole pieces plus the flux produced by the high armature current circulating around a one- or two-turn difference in field coil winding. The sparking was due to the high armature current caused by the weak field.—B.C.M.

A. TO QUESTION 179—The crossed series field connections which made both poles of the same polarity, actually resulted in an equivalent four-pole field. That is, two "phantom" poles (both assumed to be South) are set up by the flux lines from the two actual poles (North). As a consequence, this condition moved the proper brush position ahead and resulted in bad sparking.—H.S.

A. TO QUESTION 179—The question states that both fields were of the same polarity and that sparking occurred at only one place on the commutator; but did not specify that the sparking occurred under one brush.

With the brushes on kick neutral, the flux produced by the armature winding increases the leakage in the commutating area on one side and decreases it on the other, but as the condition is balanced, there will be no tendency to rotate.

However, with the brushes adjusted to the running neutral, the flux is unbalanced and rotation is possible due to the armature flux passing through the field poles increasing the strength of one and decreasing that of the other.

Excessive sparking at one point was caused by the excessive leakage flux in the one commutating area.—M.P.

Can you ANSWER these QUESTIONS

QUESTION Y7—Being unable to obtain a 440/110 volt transformer for a small single phase load, we bought two 0.250 kva., 220/110 volt single phase units. The primaries were wired in series and connected to 440-volt supply. The secondary of one transformer is used to operate a small 110-volt wheel dressing motor. The other is used to run a small fan. This arrangement works satisfactorily when both motors are used, but when the fan is shut off, the wheel dressing motor loses speed and torque. What causes this and how can it be remedied?—J.J.L.

QUESTION Z7—I have a 25 cycle, ½ hp., 110 volt, 1425 rpm., 3 ampere condenser start motor, which I would like to rewind for a 60 cycle, 110 volt 1750 rpm. of the same type, and at the same time increase the horsepower as much as possible.

Original winding data: running wind-

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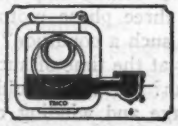

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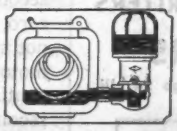

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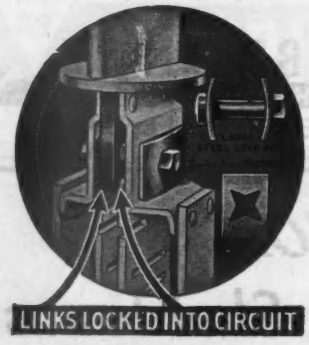

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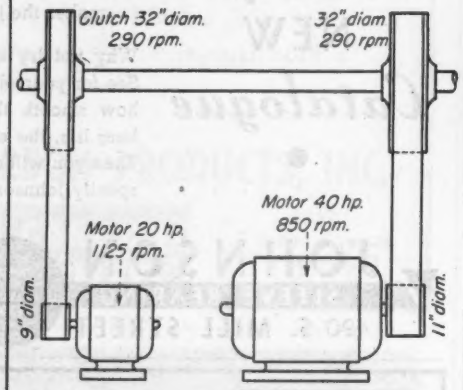
ing pitch 1–6; turns 38, 48, 56, & 60; series connected with one No. 19; condenser winding pitch 1–6; turns 64, 74, 84, & 94; and series connected with one No. 25.

Core data: slot 24; bore 2¾ inches; length of core 2 inches; tooth 3/16 inches; depth of slot 1 inch; and depth below slot ⅝ inch.

What formulas can I use to figure the new winding which will give maximum horsepower? What size condenser will be required?—J.H.G.

QUESTION A8—We have a 20 hp. motor driving a line shaft to which more load is being added. We are now installing a 40 hp. motor to be connected to the line shaft to take care of the additional load. Can we leave the 20 hp. motor connected, with the clutch idle, and in case more power is needed, connect it to the shaft by closing the clutch? To do this, the small motor would be



brought up to speed and the clutch closed with the line shaft running, powered by the 40 hp. motor.

The accompanying sketch shows motor speeds and other data on this hook-up. Will these motors work together as described without damage to either? If not, why?—C.B.J.

QUESTION B8—We have a bank of power transformers connected delta-delta feeding directly from the primary bus; that is, instead of fusing between the transformers and the bus, we have fused the feeder just ahead of the primary bus. Is this good practice? Would greater protection against single-phasing be provided by fusing each transformer lead; that is, by using six fuses instead of three as above?

As now connected, should one fuse blow, only single-phase would be supplied to the primary. Am I right in assuming that the secondary phase relationship would be zero, and that three phase motors could not start under such a condition? Would motors running at the time of such failure continue to run? What would be the secondary voltage and winding capacity?

If only one fuse blew using six fuses (one in each transformer lead) what would be the resulting voltages and capacities?—W.B.M.

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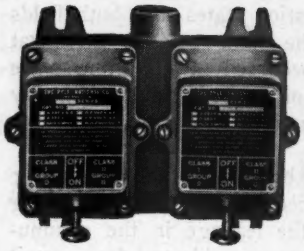

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[FROM PAGE 71]

ton chain hoists ride the rail to serve the needs of the shop. A one-ton electric hoist over the dip tank is energized by a Reelite connection and operates between the dip tank and the bake oven. Portable shop carts are used to handle numerous small equipment parts.

Good Lighting

Another feature of the new shop is a carefully engineered fluorescent general lighting system to supplement the natural illumination provided by the two large skylights in the building. Two-lamp 40 watt, RLM type fixtures mounted approximately 9½ ft. above the floor on about 11-ft. centers provide an even plane of illumination at the working level. Upper walls and ceiling are painted a light color to increase the efficiency of the lighting system.

Office facilities for the new firm are provided by one of the stores in front of the shop area with the window and front section utilized for equipment display. An adjacent store area, accessible from the office through a service arch, houses the spare parts department.

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One of the striking features of the new shop is the predominance of new modern equipment. Both Romanoff and Morgan acknowledged the importance of efficiency in motor shop operation. If they could avoid it, they didn't want to struggle with old obsolete machines in an effort to make them do a good production job. Their goal is service and to that end they decided to take their chances and sweat out equipment deliveries. A glance at the shop photos indicates that they did pretty well despite the fact that some equipment items are still "on the way." Now that operation is well under way, their accounts show a predominance (90 percent) of industrial customers.

Bud Romanoff's industrial contacts, gained while connected with the Romanoff Electric Company (one of Toledo's leading electrical contracting firms), coupled with his past shop experience and Bill Morgan's ten years of motor repair experience form the talent combination on which the shop is founded. With the critical manpower shortage problem being gradually solved, the shop that was designed for service now stands ready to serve.

These things *some* factories knew before; these things the war *proved* beyond all doubt; these things *most* production men will never forget:

- A factory must always be able to convert its production facilities quickly and easily to utilize improved methods or to meet changing demands;
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- It must fit equipment ever closer to the convenience and safety of workers;
- It must conserve floor space without creating congestion.

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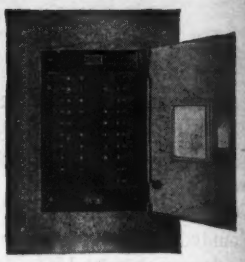
We show here 6 popular Trumbull Panelboard types, each fully described in a Bulletin (as indicated) available on request.



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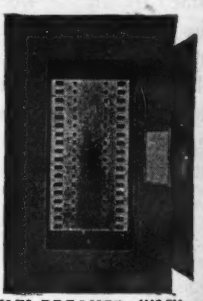

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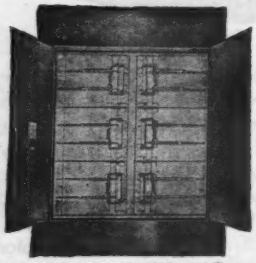

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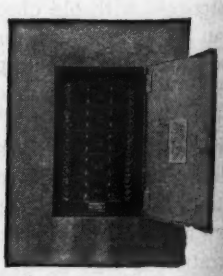

SWITCH & FUSE Lighting Panelboards . . . low cost, compact. Multiple grouping of standard parts. Tumbler switches and fuses in branches . . . 30 amp. max. Circular 326.

THE TRUMBULL ELECTRIC MANUFACTURING CO.

A GENERAL ELECTRIC ORGANIZATION

OTHER FACTORIES AT NORWOOD (CINN.) O.
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MOTOR SHOPS

JIG FOR EICHMEYER COILS

The Eichmeyer motor, of a type used to a considerable extent in elevator work is, under present conditions, coming up frequently for repair or rebuilding. Winding the armature coils of the type used in this motor requires somewhat special treatment. When completed, the coil is roughly of hexagon shape, and in bringing out the terminals, neither one can cross over the coil, and so make a hump that would prevent getting the coil in place. As a consequence, the coil is so wound that both terminals come off from the inside layer, when the coil is complete. The only way to do this is to first wind the coil on some type of form so that it will be in the shape of a U. Then, when the winding is done, the coil is divided and spread out into the form of a hexagon, as shown at the right in the sketch. In that way, the outside layers of one side of the coil become the inside layers of the other side, and both terminals come off from the inside.

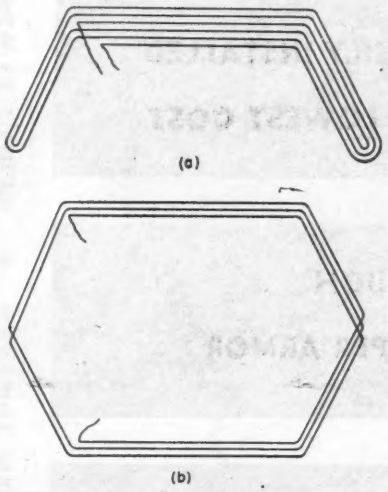
There are various ways in which this may be done, and one way, as accomplished with a jig built in the shop of the Quality Electric Co., Ltd., of Los Angeles, is shown in the photograph. With this jig, there is furthermore no necessity for the operator to cross wires.

The jig consists of a board mounted on the face of a chuck on the end of a motor-operated shaft. At one side of the board is a deep slot, which takes the wires of one side of the coil. The wires (two-in-hand winding) start in the bottom of this slot and are then carried down over the shaft of a small removable wheel mounted on the right side, the distance between the wheel and the board being just sufficient to take the wires.

From there, the wires, in successive passes, go up and over a series of stepped fiber guides on the face of the board, one for each layer; then they go down again over another wheeled shaft on the left, thence back to the beginning of the slot.

This operation results in a U-shape coil of the form shown at (a) in the sketch. When the winding is complete the wires are cut to suitable lengths for the terminals, the coil partially clipped and the wheels removed, so that the U coil can be slipped off from the jig. The wires on the steps then fall into place and are clipped. Finally, the coil is divided and opened 180 degrees to form the hexagonal coil which is shown at (b) in the sketch. It will be seen that the terminals both come off from the inside.

While this is not a fast winding operation and the wires must be guided by hand in the successive steps, power is applied to the machine (controlled by foot lever) as an aid in giving tension, resulting in a better job than could be accomplished by straight hand winding.



THE EICHMEYER MOTOR coil is first wound in U-shape form (a). It is then opened up 180 degrees to form a hexagon winding (b), in which the terminals both come off from the inside.

JIG DEVISED BY Quality Electric Co., Ltd., to wind armature coils for Eichmeyer motors is motor operated.

HEAVY DUTY GEAR AND PULLEY JACK

If you've ever struggled trying to remove a large pulley or gear from the shaft of a good sized motor you know what a chore it can be. And after it's off, you probably had a battered gear or pulley and perhaps a scored shaft in the bargain. That is—if you had no pulley jack to do the job.

This same problem was experienced at the motor repair division of the Fred W. Kiemle Company, Toledo, Ohio. The result was the development and construction of a heavy duty pulley jack. Built in the shop, the device consists of a heavy angle-iron, U-shaped base equipped with wheels and a steering handle. Mounted to a cross piece on the base is a staunch 3-ft. vertical member comprised of a support, two guide bars, and a threaded adjustment bolt equipped with a crank handle at the top. Riding up and down on this vertical member are two 38-inch lengths of 4-in. by 1-in. steel stock to which is mounted, at dead center, a 35-ton hydraulic jack. Sliding between these two cross-pieces are two 50-inch pulling-arms of the same stock, equipped with heavy steel feet

● RUBBER POWER CABLES ● VARNISHED CAMBRIC CABLES ●

BUILDING WIRE ● SERVICE ENTRANCE CABLE ● CRESFLEX NON-METALLIC SHEATHED CABLE ● ARMORED CABLE ●

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NON-METALLIC SHEATHED CABLE

FACTORY ASSEMBLED AND TESTED

EASILY INSTALLED AT LOWEST COST

TOUGH PAPER ARMOR

WEATHERPROOF FLAME-RETARDING JACKET

Particularly well suited for wiring farm buildings and low cost housing.

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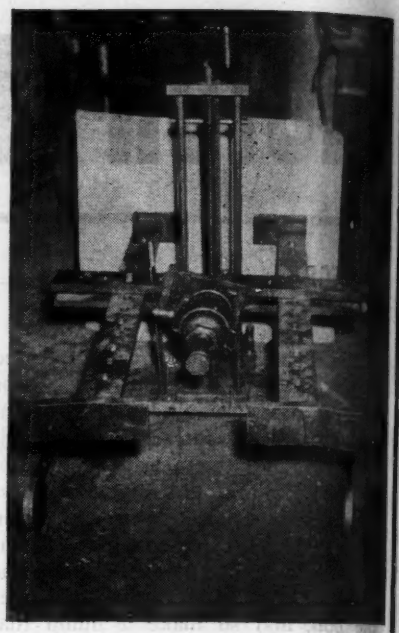
CRESCENT INSULATED WIRE & CABLE CO.

TRENTON, N. J.

● IMPERIAL NEOPRENE JACKETED PORTABLE CABLES ●



PULLEY JACK SAVES about 57 percent in labor, permits salvage of pulleys and gears and prevents damage to motor shafts at the Fred W. Kiemle Co., motor service department in Toledo, Ohio. Unit can also be taken out on field jobs.

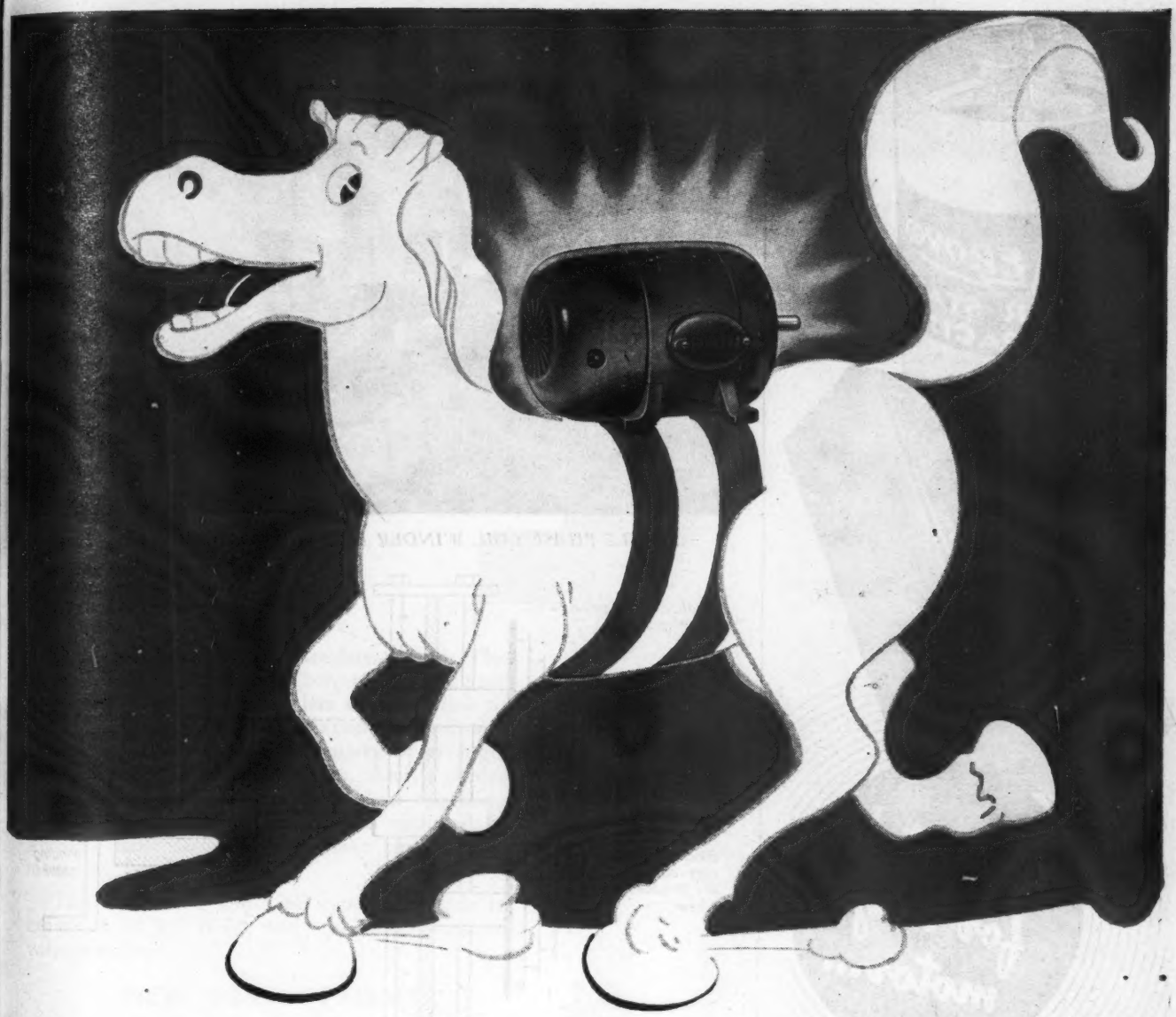
both front and rear to complete the pulling-tongs. Adjustment holes on 3-inch centers, drilled in both the arms and cross pieces, provide forward and sidewise adjustment.

When used, the unit is rolled up to the motor and the jack raised to shaft height. The pulling-arms are adjusted so they get a firm grip behind the pulley or gear and the jack plunger extended to meet the end of the shaft. Jack pressure is then increased until the pulley or gear comes off.

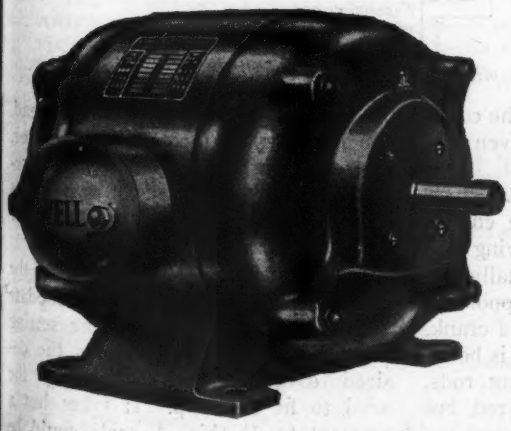
Before the unit was built, it took two men to remove a 15-in. or 16-in. diamter, 15-in. face pulley, according to shop superintendent V. A. Pinkerton. And frequently the pulley was a shambles and the shaft damaged. Now, with the pulley jack, it is a one-man job; time is cut approximately 75 percent and the pulley or gear can be salvaged. The value of pulleys salvaged alone, has more than paid for the unit, Pinkerton asserted. And what's more—it can be rolled on a truck and taken out on a field job, if necessary.

SINGLE PHASE COIL GROUP WINDER

An ingenious coil winder, for single phase armature coil groups, was built by the Adams Electric Motor Service, Los Angeles. It is not intended as a machine to be used where such coils are turned out on a large-scale production basis, but rather as a tool that the electrician can attach to his bench vise and with it do individual jobs as they



It may come to this—
but we won't cut Howell Quality



The Howell Protected Type Motor, shown, gives complete protection against dripping liquids, metal chips and other falling particles. Completely streamlined—utilizing non-breakable steel frame—malleable or steel base—cast iron end plates and cast iron, weatherproof terminal box are standard construction features. Special horizontal and vertical mountings are available.

Available in sizes 5 H.P. and smaller. Other sizes and types available up to 150 H.P.

Yes, it may even come to the point where we have to press the good old Howell Horse into service to make deliveries on our famous motors. That's how serious the delivery situation is in the entire electric motor industry today.

But there's one thing you can count on now, as always—*we'll never, never cut Howell quality.* Every Howell Motor is built of the finest material, statically and dynamically balanced, and thoroughly insulated throughout.

So, until the delivery situation clears up, please bear with us. We recognize our obligations fully. We are putting forth our maximum efforts to build more and more Howell Motors, and to see that they are distributed among users whose needs are most vital to the war effort. This, we know, is as you would have it.

HOWELL ELECTRIC MOTORS COMPANY

HOWELL, MICHIGAN

Manufacturers of Quality Motors Since 1915

● Yes sir, Aerovox motor-starting replacement capacitors are a match (match box used for size comparison) for any standard capacitor-type motor.

Only 28 universal numbers—22 for 110-volt, 6 for 220-volt—take care of upwards of 90% of all motor-capacitor replacements. Handy Aerovox conversion chart indicates proper universal types for any previously available exact-duplicate replacements. Minimum stock; maximum service.

● **Ask Your Jobber . . .**

Ask about Aerovox motor-starting capacitor replacements. Ask to see the handy conversion chart. Ask for catalog. Or write us direct.

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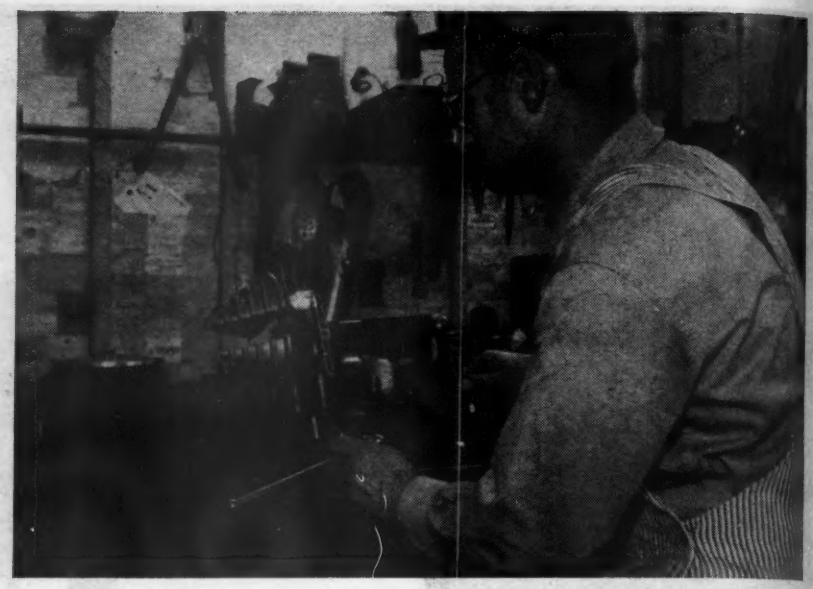
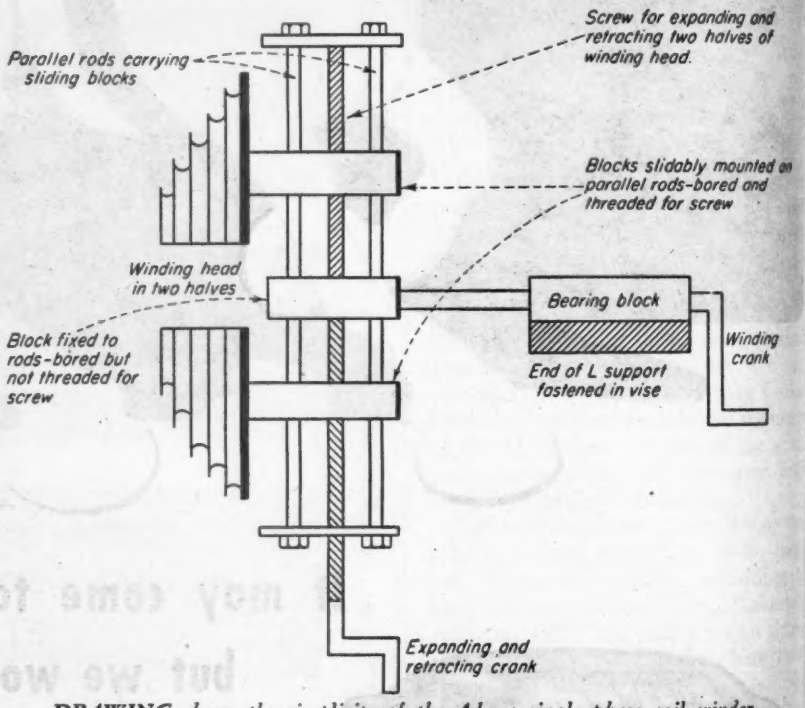


SINGLE PHASE COIL WINDER has a split, retractable winding head.


Parallel rods carrying sliding blocks
Screw for expanding and retracting two halves of winding head.
Blocks slidably mounted on parallel rods-bored and threaded for screw
Winding head in two halves
Bearing block
Winding crank
Block fixed to rods-bored but not threaded for screw
End of L support fastened in vise
Expanding and retracting crank

DRAWING shows the simplicity of the Adams single phase coil winder.

come along, more quickly than he could set up for them on a power-driven machine.

The winder is fixed to an L-shaped strip of heavy strap iron, one end of which fastens in a vise, leaving the other end to project horizontally.

At right angles to this supporting arm is a shaft turned by a hand crank. A block extension of this shaft is bored to take two parallel supporting rods, which are fixed to it. It is bored, but not threaded, to pass a screw rod between the supporting rods.

Mounted on the parallel supporting rods are two sliding blocks, bored and threaded for the screw rod, the upper and lower ends of the screw rod and their respective sliding blocks being oppositely threaded. On the outer ends of these sliding blocks are mounted the two halves of the winding head, which is split through the center. Therefore, as the expanding and retracting crank is turned the two halves of the head may be drawn together or forced apart.

In operation, the two halves of the winding head are set to accommodate certain sizes of coils, and the setting is made by forming a loop of the desired diameter and expanding the head to fit the loop. It takes but a moment to do this. A scale could be mounted on the bars indicating different coil diameters, but such a scale setting would probably need to be checked with an actual loop.

When the coil group is completely wound, the two halves of the winding head are retracted and the coils can then be readily removed.

Which of these transformer assemblies will do the best job for you?

Standard
TRADE MARK

FOR RURAL LINE SERVICE

TYPE AR

ARP with valve arrester

ARP with double gap arrester

CSP single bracket

TYPE SRO

SRO with double gap arrester

SRO with valve arrester

Any of the above can be furnished with single or double mounting brackets

Rural transformers as manufactured by The STANDARD Transformer Company are not a cut and dried proposition. Builders of a full line of rural transformers, STANDARD installs "built-on" protective devices in a wide variety of arrangements to meet your requirements. And, a choice of accessories to meet your individual operating standards and requirements is also included in alternate tank designs which have two or four mounting brackets.

The AR, ARP, and CSP types are made in capacities of 1.5 KVA and up, in all standard voltage ratings.

NEW DEVELOPMENT

To meet the need for a small, low loss, and high efficiency transformer at low cost to handle small loads, STANDARD has developed a type called SRO. This new unit has ratings of 1 KVA for voltages up to 7620.

You will find upon further investigation that STANDARD'S transformers keep losses at a minimum and stimulate continuity of service. Therefore, write without further delay for bulletins S-301 and S-301-A.

THE STANDARD TRANSFORMER CO.

WARREN, OHIO

OFFICES IN PRINCIPAL CITIES

The STANDARD Transformer Co.
Warren, Ohio

Please send Bulletin S-301-A on SRO type transformers and S-301- on AR, ARP, and CSP types.

Name_____

Company_____

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THE SPECIALISTS IN TRANSFORMER DESIGN FOR OVER 25 YEARS

Without disturbing Conduit

Only with Kondu can you take out one fitting and put in another, without disturbing conduit. Every Kondu box is a union.

Only with Kondu can you use ANY kind of conduit at ANY outlet.

Vibration - proof, Kondu holds permanently tight. Practically unbreakable — 100% re-usable. *Write for the Kondu Catalog.*

KONDU CORPORATION
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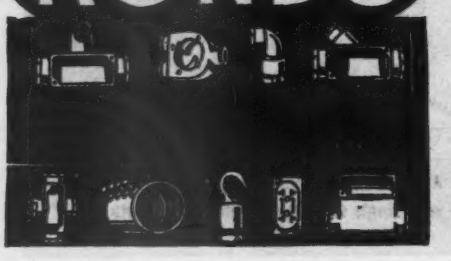
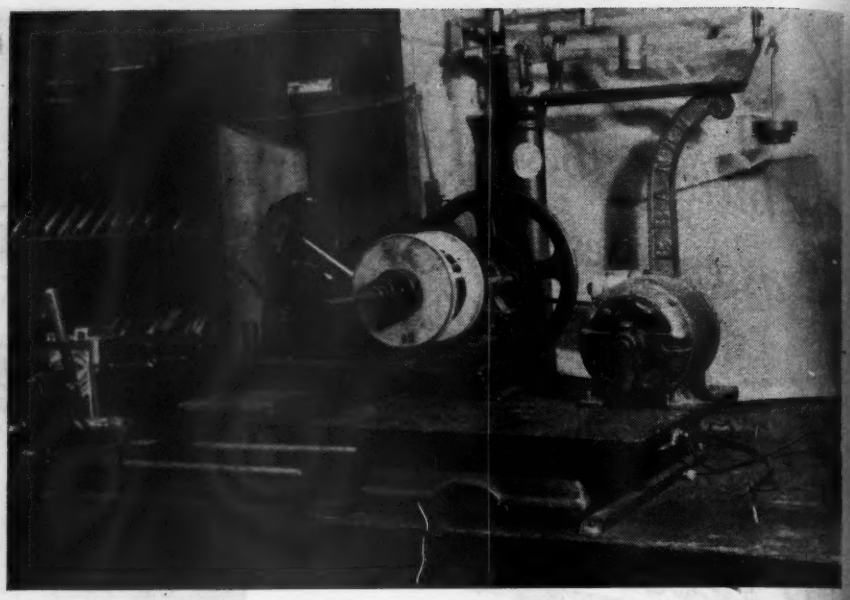
KONDU MFG. CO. LTD., Preston, Ontario

KONDU





BEAM SCALE, with winder and motor balanced, measures fine wire by weight as it is spooled.

MEASURING WIRE FOR COILS BY WEIGHT

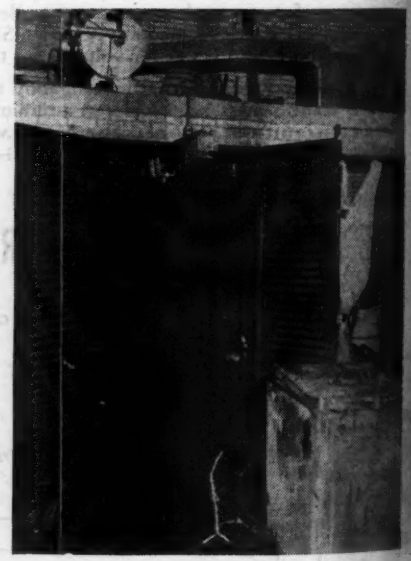
About the easiest way to measure fine wire is to weigh it, determining length or number of turns per coil by calculating from gauge of wire, number of turns and length of average turn. Accordingly, Kuchel & Sievers, San Francisco, mount a coil winder with its motor on a base made to fit the platform of a small scale. The beam is made to balance at zero under the weight of the assembly empty. Weights are then adjusted on the scale arm to the desired weight of wire to be wound on the coil. Winding then progresses until the scale arm lifts, showing when the required amount has been wound on.

TRANSITE FLUE BEST FOR DEGREASER UNIT

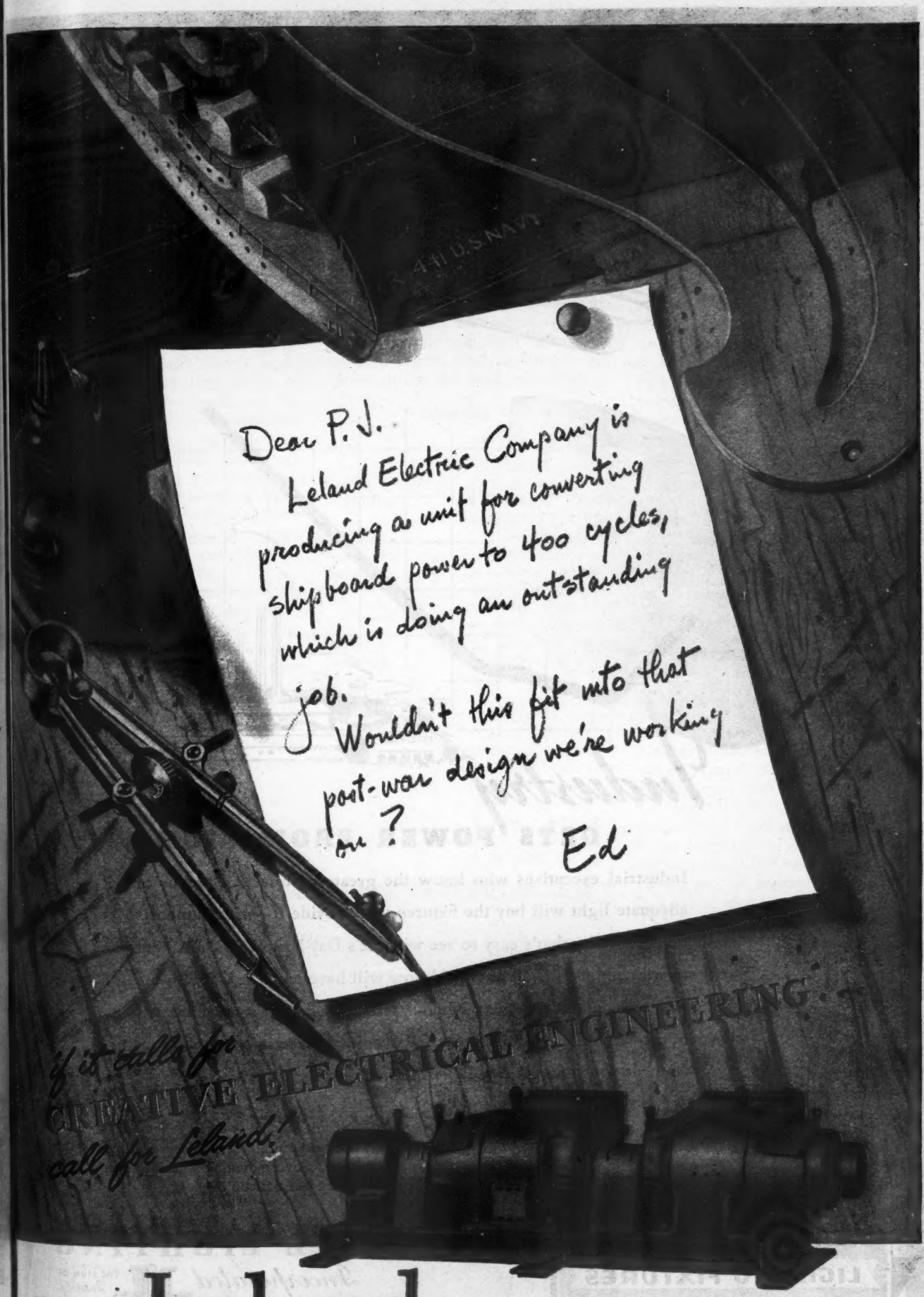
Experience has proved to the Fred W. Kiemle Company motor repair department at Toledo, Ohio, that Transite pipe provides the most satisfactory flue for their degreaser unit. Previously they had used galvanized iron pipe but, after four or five months of operation, this became so clogged with scale that it hampered efficient operation of the unit and had to be renewed at the end of a year.

The flue is an exhaust and draft (not a fan induced forced draft) connected to the base of the degreaser to carry off the products of combustion of the gas burner which heats the solvent in the degreaser tank. Some of the solvent (stabilized trichlorethylene) may seep through a leaky clean-out door of the tank and get over the gas flame. This causes a decomposition which results in a rusting condition on the interior of the draft flue. The flue may become so filled with scale that the draft is reduced to an extent where it affects combustion at the gas burner and may prevent the solvent from being heated to the proper temperature. Then a replaced flue is the only effective solution.

At the Kiemle shop, they decided to try Transite (asbestos-cement) pipe. Accordingly, a 6-inch diameter flue—extending some 12 feet above the roof of the shop—was installed. They have had no trouble since. The more costly initial investment is offset by the more efficient operation of the degreaser and the elimination of annual replacement of the flue. Manufacturers of degreasers generally prefer Transite flues.



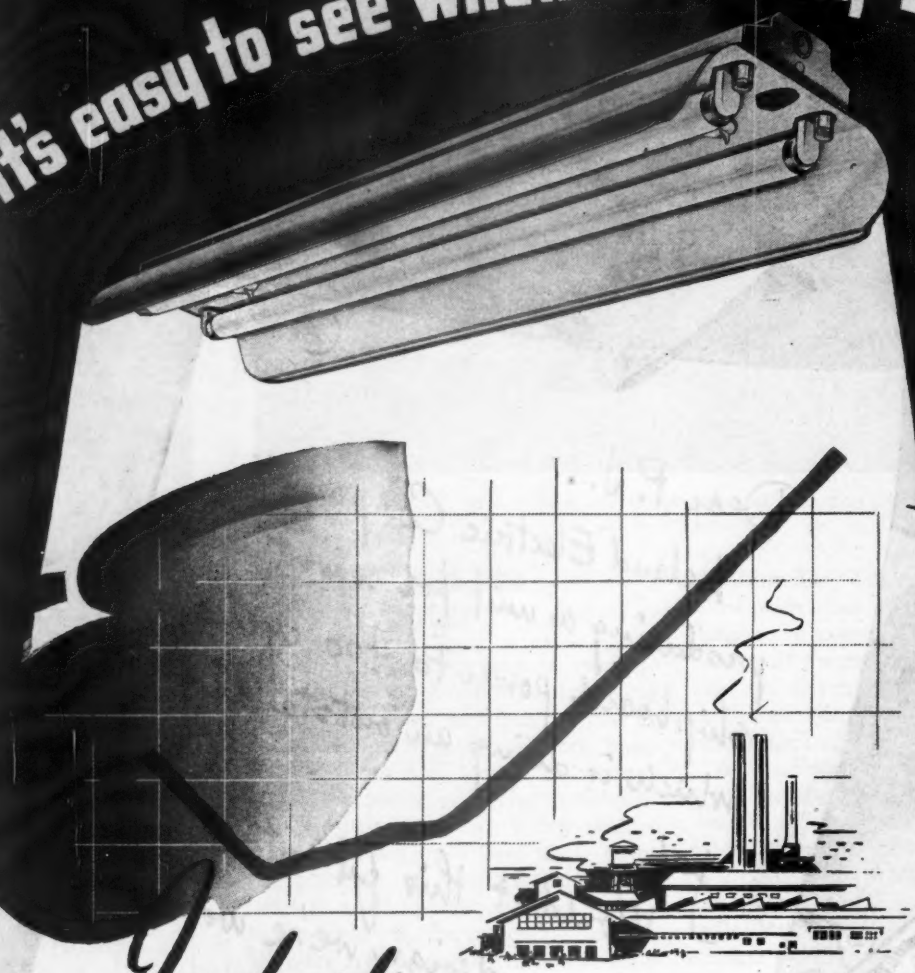
WALK-IN OVEN at Fagan Electric Co., Little Rock, Ark., has four rows of hooks set in roof from which small motors and parts can be suspended. Heavy mono-rail is for large armatures and rotors. Heavy equipment can also be placed in oven on hand truck. The oven is fired with natural gas.


Dear P. J.
Leland Electric Company is producing a unit for converting shipboard power to 400 cycles, which is doing an outstanding job.
Wouldn't this fit into that post-war design we're working on?
Ed
If it calls for CREATIVE ELECTRICAL ENGINEERING call for Leland!

THE Leland ELECTRIC COMPANY

DAYTON, OHIO • IN CANADA, LELAND ELECTRIC CANADA, LTD. . . . GUELPH, ONTARIO

it's easy to see when it's "Day-Brite"



Industry

GETS POWER FROM LIGHT

Industrial executives who know the greater productive power of adequate light will buy the fixtures that provide it—with emphasis on the quality that's easy to see when it's Day-Brite. . . . The extent to which you cultivate this field now will have much to do with the business harvest you reap when war is ended, and new standards of production precision are carried over into peacetime competition. Consult your nearest Day-Brite Engineering Representative.

RLM

The **DAY-LINE**, pictured above, is a heavy-duty industrial fixture, with porcelain enameled steel reflectors, for unit or continuous-run mounting with Day-Brite "Ice-Tong" Hangers. Get Bulletin F-77.

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DAY-BRITE LIGHTING
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• *Nationally distributed through leading electrical supply houses*

MODERN LIGHTING

DRAFTING ROOM INSTALLS FLUORESCENTS DIAGONALLY

Graduate pupils of the Pontiac Vocational School, Pontiac, Michigan, consisting of trained draftsmen, machinists, welders, printers, aircraft mechanics and pattern makers, are playing their part in World War II, many in the battle of production, others in service overseas. Instructors at the school give credit to new fluorescent lighting for reducing the physical strain of learning and for materially speeding up the rate at which students assimilate the material. They state that the improvements in lighting have made the work easier for both instructors and students by reducing eye strain and resultant fatigue.

In the drafting room, more than 50 footcandles average is provided on the working plane. The lighting equipment used consists of 19 Wakefield fixtures, each equipped with two 100 watt white fluorescent lamps, arranged in five continuous rows. These are installed ten feet from the floor on 7½-foot centers, diagonal to the tables to provide better control of shadows from T-squares and triangles.

The drafting room is 26 feet wide by 40 feet long and has a 12-foot ceiling height. Reflection factor of the ceiling and side walls is approximately 70 percent. The fixtures used are semi-direct lighting type, shielded with louvers to prevent direct glare. Reflected glare is minimized by a resultant high level light intensity which approaches the brightness of the reflected image of the fluorescent lamps. Luminous reflectors light the ceiling softly to relieve contrast between the fixture, ceiling and wall brightness.

Engineering Data

Area	26 ft. by 40 ft. or 1,040 sq. ft.
Ceiling Height	12 ft. 0 in.
Mounting	Continuous row suspended 2 ft. 0 in.
Spacing	7 ft. 6 in. on centers
No. Units	19 units in five rows
Type	Wakefield semi-direct louvered for two 100 watt fluorescent lamps
Wattage	4.3 watts per sq. ft.
Intensity	50 footcandles average.
Comments	From data given, coefficient of utilization of .65 results. Diagonal mounting of continuous row fixtures and illumination of ceiling softens shadows and gives good brightness ratio.

DIAGONAL MOUNTING of continuous row two-lamp 100 watt Wakefield fluorescent fixtures provides 50 footcandles of shadow-controlled illumination in drafting room at Pontiac Vocational School, Pontiac, Michigan.

INDIRECT FLUORESCENT FOR PHOTOGRAPHIC LAB

Photography is attaining an enviable position in modern industrial plant operation. In addition to being used for personnel identification purposes, for recording construction progress or department layouts, it is proving a useful tool for design and laboratory engineers. Photographic rooms, like other specialized areas, require adequate and proper lighting for the task at hand.

At the Allison Division, General Motors Corp. Plant No. 5 in Indianapolis, where the Allison liquid cooled air craft engines roll off the assembly lines, photography is used to maintain case history records of engine parts that fail under test. Each part that fails is photographed from various angles and positions. With such records as a background, design engineers and metallurgists tackle the problem of finding out the "how and why" of the failure; of determining what is to be done to eliminate such failures.

Photographing highly polished, specular surfaces, such as precision machined aircraft engine parts present, is a ticklish problem, particularly from the standpoint of lighting. Unless the proper type of lighting is used, highlights and shadows may appear on the photograph. Frequently the details of the part photographed are entirely lost due to incorrect lighting.

Considerations of this nature led to the installation of totally indirect fluorescent lighting for general illumination of Allison's laboratory photographic room. Cove lighting was installed along the two walls of the 7½-ft. by 19-ft. room. Continuous inverted troughs made up of four sections—each containing two parallel 40-watt, 3500 degree white fluorescent lamps—were mounted 26 inches *from* the 10-ft. ceiling on each side wall. Ceiling and walls above the troughs were painted white; walls below the units were painted a light green color.

Lighting intensities derived from this indirect fluorescent system average 60 footcandles at a 44-inch working plane and 50 footcandles at a 26-inch horizontal plane. Fluorescent was chosen because of its long diffused light source (diffused quality of illumination further accentuated by the indirect application) and its cool operation (60

How Needless blows from

EITHER SOURCE

OF HEAT ARE

PREVENTED IN

PIERCE

RENEWABLE FUSES

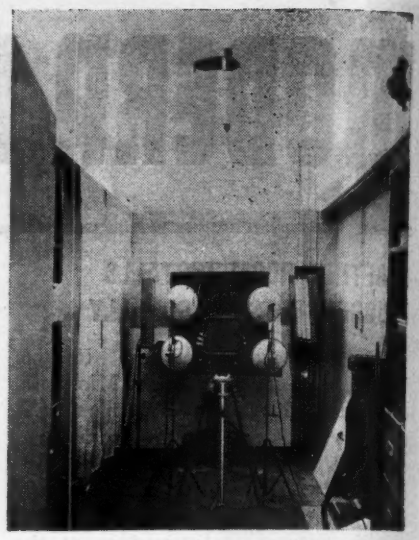
Although half of the heat developed in the blowing sectors of *any* link flows into the knife blades, the other half moves into the midsections of the link. Here, *Pierce alone* reaches in with a moving column of air (through safety-screened end vents), and carries the heat out, avoiding needless blows from harmless jolts that can cause "Link Saturation."

ALL SIZES
250 V. 600 V.
0-600 AMPS.

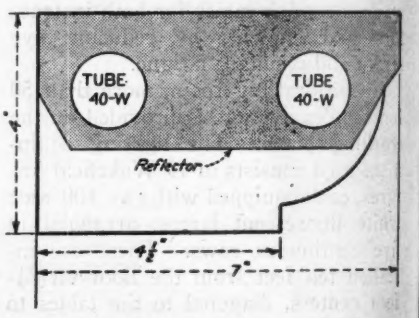
By simple two-piece assembly, and sturdy tubular-arch support of blades and link in a single inner unit, Pierce makes link changes easy and secure and assures permanent knife-blade alignment. Positive contact goes straight through, avoiding needless blows from "poor contact" heat.

SOLD THROUGH LEADING DISTRIBUTORS

PIERCE RENEWABLE FUSES INC.
211-219 HERTEL AVENUE
BUFFALO 7, NEW YORK



INDIRECT FLUORESCENT lighting provides from 50 to 60 footcandles (depending on working plane) of cool, highly diffused, general illumination in this plant laboratory photographic room —a quality highly desired for photographing polished, specular parts.



CROSS SECTION of the continuous indirect fluorescent trough mounted to each side wall of the photographic room. Two 40-watt, 3500 degree white lamps are in each section. Four sections comprise the trough for each wall.

footcandles of incandescent lighting in this small room would have added materially to the air conditioning load).

The fluorescent general lighting may be used alone (for some purposes) or in conjunction with supplementary back lighting or floodlighting. When used in the latter application, it aids materially in counteracting any undesirable highlights or shadows that the photographic problem may involve.

FLUORESCENT LIGHTING IN A PAINT SPRAY BOOTH

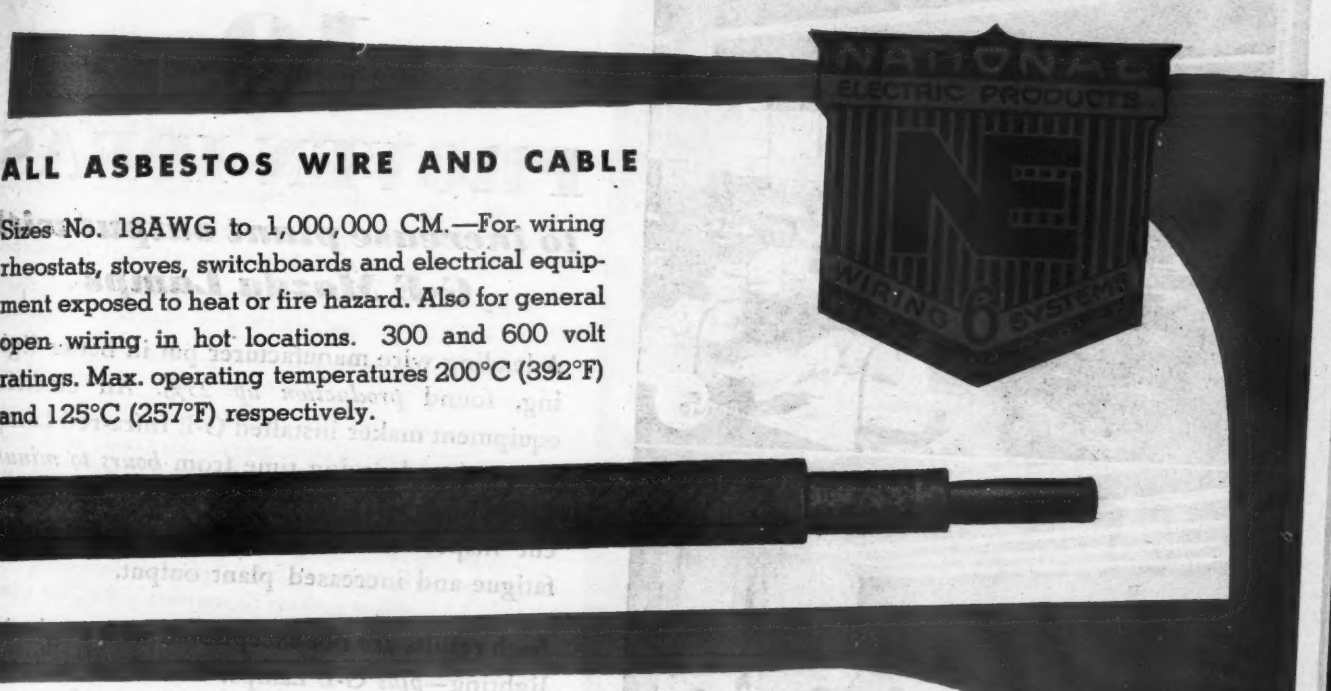
The long light source, low brightness and diffused illumination provided by the fluorescent lamp has led to its adoption as standard lighting equipment in all paint spray booths at the Texas Division plant of North American Aviation, Inc. Typical of the lighting schemes employed is that

For HOT SPOTS use "Easbestus"

WIRES and CABLES

A name to remember for installations where heat, flame, oil, moisture, grease and corrosive fumes prevail, and where rubber, Neon (thermoplastic) and varnished cambric insulations are unsuitable.

Illustrated are two examples from our wide range of asbestos and asbestos-varnished cambric insulated wires and cables. Literature and complete engineering data on request.



ALL ASBESTOS WIRE AND CABLE

Sizes No. 18AWG to 1,000,000 CM.—For wiring rheostats, stoves, switchboards and electrical equipment exposed to heat or fire hazard. Also for general open wiring in hot locations. 300 and 600 volt ratings. Max. operating temperatures 200°C (392°F) and 125°C (257°F) respectively.

ASBESTOS-VARNISHED CAMBRIC CABLE

Sizes No. 18AWG to 1,000,000 CM.—For power circuits and general hot spot wiring in boiler rooms, steam tunnels, etc. 600 to 8000 volt ratings. Max. operating temperatures 110°C (230°F) and 91°C (196°F) respectively.

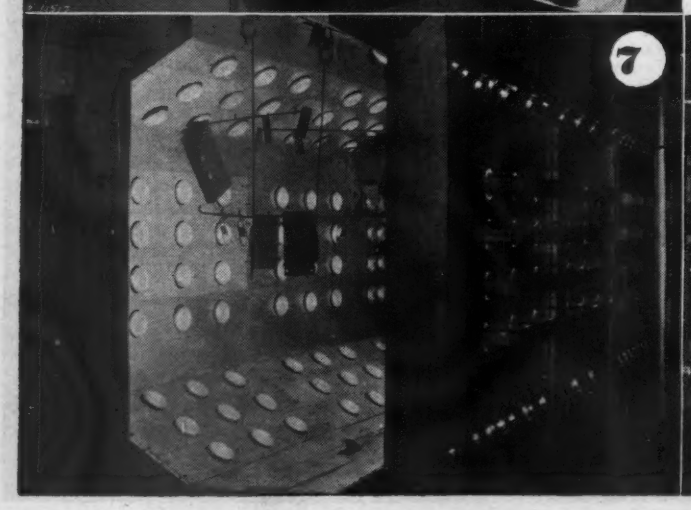
National Electric
PRODUCTS CORPORATION
Pittsburgh, Pa.

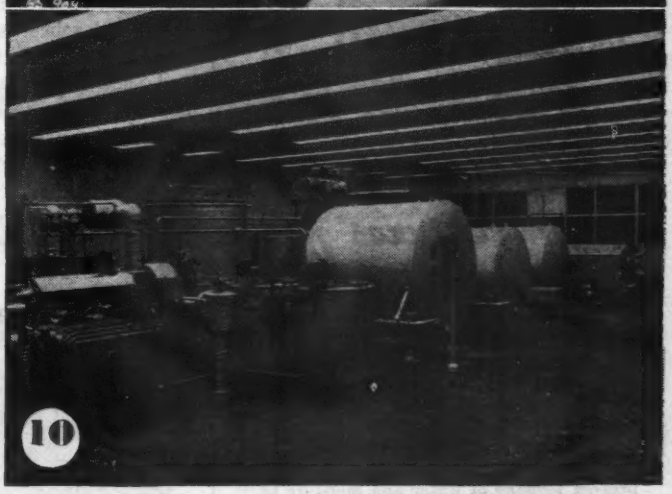
10 PROVEN IDEAS

to increase plant output with G-E Mazda Lamps

A leading wire manufacturer put in better lighting, found *production up 25%*. An electrical equipment maker installed G-E Infra-red Lamps, thus reduced drying time from *hours to minutes*. In shell manufacturing, G-E Mazda Lamps have cut inspection time — reduced eye-strain and fatigue and increased plant output.

Such results are not exceptional with engineered lighting—*plus* G-E Lamps. In the ten successful installations shown here, G-E Mazda Lamps provide high-efficiency, low-brightness illumination at low cost. You know where these ideas can help—why not put them to work?





1. Fewer mistakes in this *drafting room* because G-E Fluorescent lighting reduces shadows to a minimum.
2. *Safety hazards* are sharply reduced when G-E Mazda Lamps provide high-level illumination for safer seeing.
3. Extremely fine *detail work* moves faster, better, more accurately with abundant light furnished by G-E Lamps.
4. This *inspection* operation uses low brightness, high footcandle lighting to spot defects in steel ribbon.
5. High footcandles for close *assembly* work save rejects and reduce spoilage. G-E Mazda Lamps help do it.
6. Adequate *office lighting* with G-E Fluorescent Lamps provides better working conditions, raises morale.
7. Versatile G-E Infra-red Lamps save time—speed production in this oven *drying* installation.
8. Soft, diffused fluorescent light from G-E Lamps enables *supervisors* to maintain high standards of efficiency.
9. High *precision* depends on accurate readings. Abundant, glare-free lighting with G-E Mazda Fluorescent Lamps will make instrument reading easier.
10. With high levels of cool fluorescent light from G-E Lamps, this plant maintains *quality*, promotes cleanliness.

CONSULT your nearby G-E Lamp Office or your G-E Lamp supplier. More than 60 years of technical skill and engineering knowledge are available to solve your problems. Better call today.

"TO MAKE G-E LAMPS STAY BRIGHTER LONGER"

The Constant Aim of G-E LAMP RESEARCH

G-E MAZDA LAMPS

BUY MORE WAR BONDS

GENERAL ELECTRIC

...the G-E radio programs: "The G-E All-Girl Orchestra," Sunday 10:00 p. m. EWT, NBC; "The World Today" news, Monday through Friday 6:45 p. m. EWT, CBS; "The G-E Houseparty," Monday through Friday 4:30 p. m. EWT, CBS.

Improved

for greater usefulness

Watertight Socket fits snugly on side of lamp.

Concave Wire Outlet with pliable rubber opening that grips wires tightly and effectively seals end of handle.

New Features for Popular 7000 Guard Series

Guards in every sense of the word . . . the new McGILL 7000 Series protects not only light bulb but all connections to it.

Note in the illustration above the Watertight rubber socket and the rubber seal in the handle end . . . both of which prevent seepage of water and moisture to the interior. Connections, light bulbs, users . . . all THREE are protected by this new McGILL construction, every detail of which passes the rigid requirements of Underwriters' Laboratories. This guard can also be furnished with McGILL composition socket if desired.

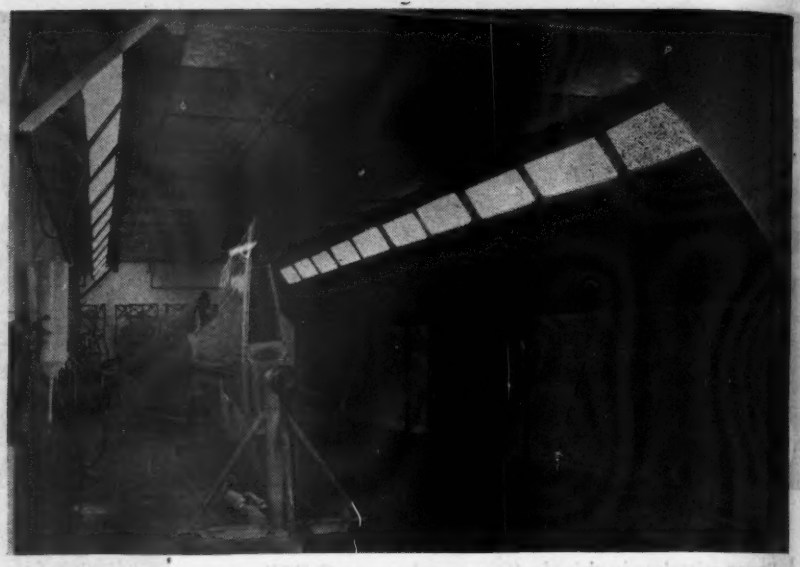
There's a size and type for every need . . . in industrial plants, garages, railroad work, etc. Write for complete details.

McGILL MANUFACTURING CO.
Incorporated

VALPARAISO, INDIANA

Electrical Division

McGILL



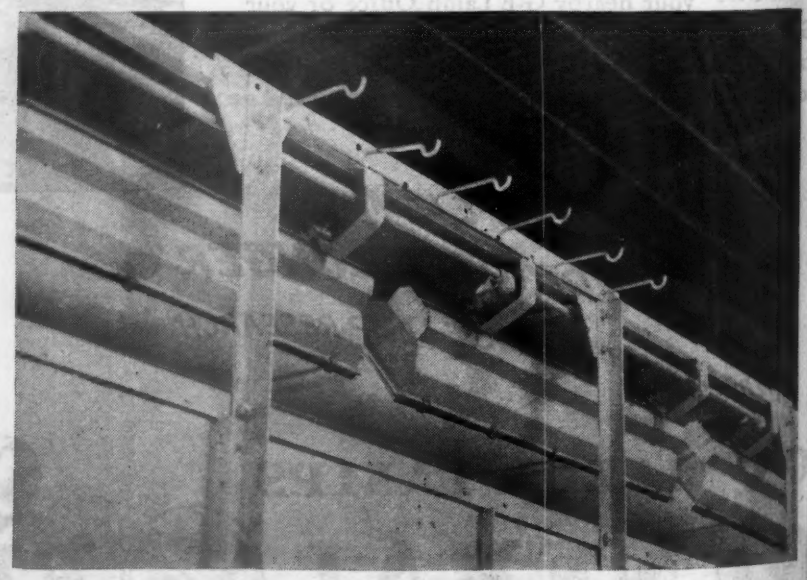
ANGLE LIGHTING provides the necessary vertical illumination in this spray booth where aircraft wing sections are painted. Vapor-proof fluorescent units produce 45 footcandles of cool, diffused illumination on the wing sections.

illustrated in the attendant photographs of a booth in which wing sections are sprayed.

Illumination of 45 footcandle intensity on the working plane is provided in this specific installation by a total of 20 RLM, industrial type, vapor-proof rows of ten units each on each side of the booth. Individual fixtures contain three 40-watt, 3500 degree white, fluorescent lamps enclosed by a wire-mesh glass cover made vapor-proof by a braided asbestos gasket between the glass and the reflector.

To secure a substantial vertical component of the total light distribution, the fixtures are mounted at a 45 degree angle at the juncture of the booth ceiling and walls. Spacing of units is practically end-to-end, there being only a few inches between adjacent fixtures. Special brackets project the units slightly inside the booth proper and keep them a few inches from the ceiling. The wall of the booth behind the units is open to permit the exhaust system to pull a substantial quantity of fresh air over the fixtures and thus reduce the concentration of ignitible vapor around the units. When spraying is done, the exhaust, coupled with a water wash system, draws most of the paint laden air from the booth before it has a chance to concentrate at the ceiling level.

In other booths, where more illumination on the horizontal plane is required, fluorescent units installed flush in the booth ceiling supplement the angle lighting systems. Explosion-proof or vapor-proof conduit fittings, whichever the inspection authorities demand, are used throughout the installations.



MOUNTED IN THE OPEN, the fixtures are subjected to a continuous circulation of fresh air, drawn in by exhaust system, which reduces concentration of paint laden vapor around the units. Braided asbestos gaskets are installed between the wire-mesh glass cover and fixture reflector.

they all agree on

...because THESE INDUSTRIAL FLUORESCENT FIXTURES OFFER GREATEST ALL-AROUND ADVANTAGES YET CONCEIVED

In MITCHELL-lighted plants everywhere, *workers* see better . . . do more . . . tire less. Up goes morale. Up goes production. But that's not all. *Maintenance men* find MITCHELL units easier to mount . . . simpler to service. *Plant owners* are quick to recognize these benefits. They heartily "O.K." the sound engineering . . . the rugged durability . . . the true economy of these certified fixtures. In the complete MITCHELL line of 2-40 watt, 3-40 watt, and 2-100 watt models they find the right answer for their particular lighting problem.

To the *distributor* and *contractor*, all this means easier sales . . . greater customer service . . . volume business . . . maximum profits. Everyone agrees on MITCHELL. *No wonder!*

BUILD SALES WITH THESE AIDS!
Distribute full-size Catalog No. 281 and Pocket-size Catalog No. 290. Each tells full story.

All These Features

ALL-STEEL REFLECTORS, WIREWAYS
OPEN-END OR CLOSED-END
BAKED OR PORCELAIN ENAMEL
"AIRCRAFT" INSTANT-LATCH
INSTANT-START MODELS
EASY-MOUNT ACCESSORIES
SINGLE OR CONTINUOUS ROW
SURFACE OR SUSPENSION
U. L. AND E. T. L. APPROVED
RLM CERTIFIED

MITCHELL
FIRST IN POPULARITY

Mitchell Manufacturing Company
2525 CLYBOURN AVENUE, CHICAGO 14, ILLINOIS
West Coast Factory and Sales Office: 1019 N. Madison Ave., Los Angeles 27, Cal.

RLM Heavy Threaded Deep Bowl Reflector and Socket Hoods

RLM Threaded Dome Reflector

QUAD LIGHTING UNITS

QUAD Units have proved themselves in long-time service. Contractors enthusiastically endorse them because they live up to their claims—they give good lighting efficiency for long periods and require little attention. Install QUADS for industrial or commercial installations—indoor or outdoor. Good business is the result. QUAD . . . for today and for tomorrow.

Manufacturers of Incandescent Lighting Equipment

QUADRANGLE MFG. COMPANY

32 S. PEORIA ST.

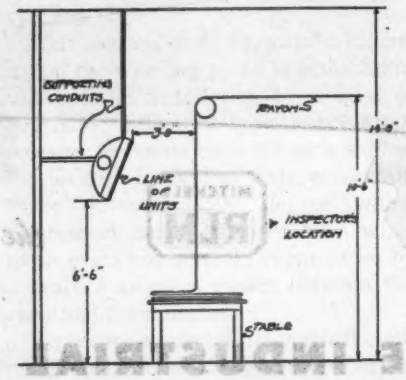
CHICAGO 7 ILLINOIS

LOCAL LIGHTING DETECTS WEAVING FLAWS

Highly diffused, local incandescent lighting has proved the solution to detecting flaws the size of pinholes and larger in textile plant inspection work. In this particular instance—the rayon cloth comes off of the dry end of the tenter, is carried over a roller and down a nearly vertical plane through suitable guides, where it is picked up on a table. As the translucent fabric is passed between a light source (either natural or artificial) and the eye of the inspector, any holes are easily detected by the change in brightness between the holes and the surrounding material.

An artificial skylight of suitable uniform brightness was provided by four Benjamin Skylight diffusing units No. 5618. The openings of these reflectors are covered by highly diffusing opal glass. Each three-foot unit is lamped with two 150-watt, inside-frost incandescent bulbs. The four units are placed side to side approximately three feet back of the cloth. Since the material may vary from forty inches to one hundred and forty inches in width, each unit is individually switched to provide a suitable flexibility of control. After two years of operation, measured brightness of the lighted glass panels was found to be 360 footlamberts, with an illumination of 80 footcandles thrown on the cloth.

This lighting data was submitted to the Lighting Service Forum of the Illuminating Engineering Society by the New York Power and Light Corporation, Albany, N. Y.



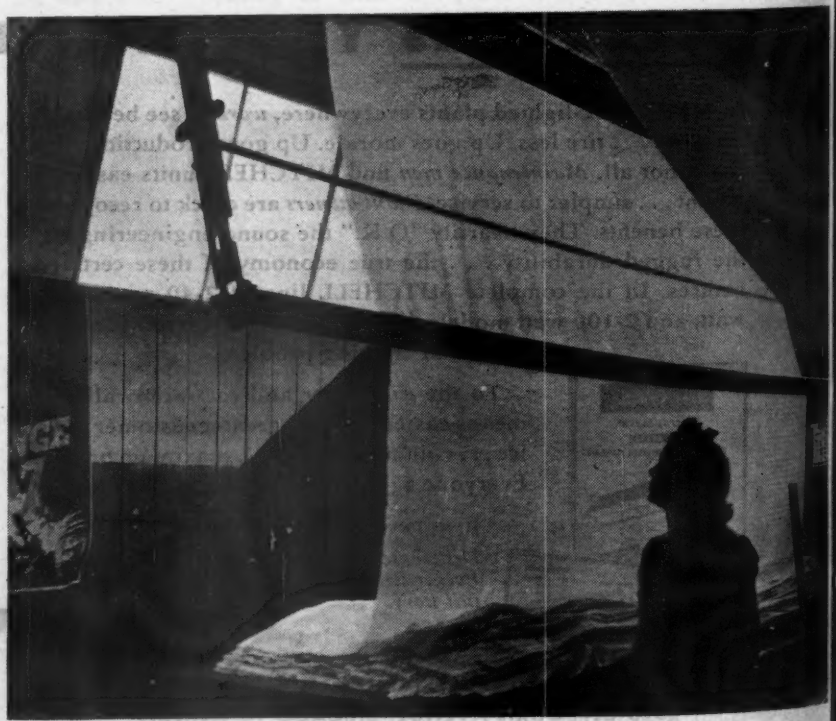
LENGTH WISE ELEVATION is shown of dry end of tenter.

ARTIFICIAL SKYLIGHT FOR DRAFTING ROOM

The Lundberg Engineering Company in Chicago has solved its drafting room illumination problems by the installation of a fluorescent artificial skylight used in conjunction with controlled natural light.

The area is 31 feet by 46 feet with a maximum clear ceiling height of 21 feet. The sloping of the upper side walls was not conducive to using the ordinary accepted practice of providing illumination. Venetian blinds are used to control natural daylight.

The illumination requirements were satisfied by designing and installing an artificial skylight which covers 12 feet by 28 feet and is flush but not fastened to the ceiling. It is suspended



GENERAL VIEW of local inspection lighting of textiles.

OUTSTANDING

FOR HIGH-BAY INSTALLATIONS

When all the selling arguments are weighed against facts in the case, the subject of high-bay lighting efficiency is always in favor of the Curtis "X-Ray" Silver Mirror Glass Reflectors. These reflectors are the result of all the experience of decades of leadership in the lighting field. The function of these reflectors is to deliver more light to the illuminated area . . . and this is a job they do superlatively well.

Any lighting contractor or salesman who is up against competition on high-bay installations can arm himself with engineering facts and figures that will give him a convincing edge every time.

"X-Ray" Industrial lighting reflectors are made in three distinct types and several sizes, each of which has specific advantages for certain purposes. Illustrated above is the largest (750- to 1500-watt) size.

Inform yourself of all of the facts . . . and then go after high-bay lighting for profitable volume sales. Write today for specification sheets.

CURTIS *Lighting*, INC.

6135 WEST 65TH STREET, CHICAGO 38, ILLINOIS

THE REFLECTOR IS THE BACKBONE OF ANY LIGHTING SYSTEM . . .

Skilled Lighting!

Helps make Skilled Hands!

Skilled work thrives on *Skilled Lighting*. Down goes the costly record of errors often due as much to blinding glare as uncertain shadow. Up goes production, both in quality and quantity, thanks to evenly distribnted, shadow-free *Light* – the kind that Wheeler engineering has made famous throughout industry!

Better work and reduced costs are practically automatic when you install Wheeler Reflectors – the product of 64 years of specialized lighting experience. For they are engineered to get maximum illumination from *standard lamps*. And because of their efficient design, heavy duty materials, and high grade vitreous enameling, they stand up longer, require less maintenance.

Learn how you can lighten the load on your workers – and your operating costs. Send for catalogs showing complete line of incandescent and fluorescent lighting fixtures. **Wheeler Reflector Company, 275 Congress St., Boston 10, Mass.** Also New York. Representatives in principal cities.

All-Steel Open-End Fluorescent Unit

Available for two or three 40-watt, or two 100-watt lamps. Broad wiring channel with accessible, enclosed ballast. Can be mounted from chain or conduit, individually or in continuous runs.

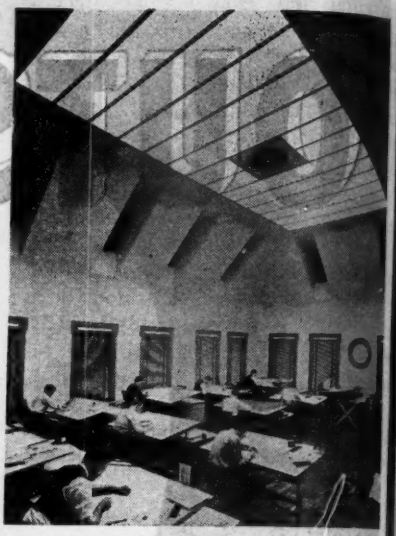
RLM Solid Neck Incandescent Reflector

Maximum lighting efficiency for either indoor or outdoor use. Expertly designed, ruggedly built. 75 to 1500 watts.

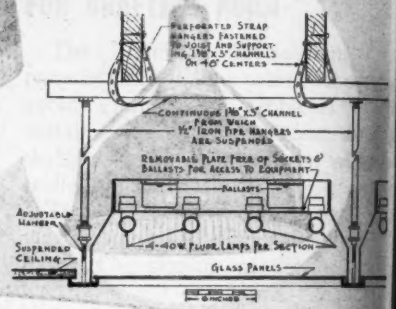
Distributed Exclusively through Electrical Wholesalers

Wheeler Skilled Lighting REFLECTORS

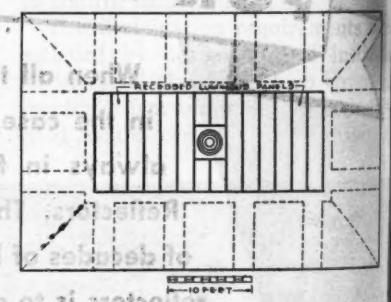
Made by Specialists in Lighting Equipment Since 1881



GENERAL VIEW of the drafting room.

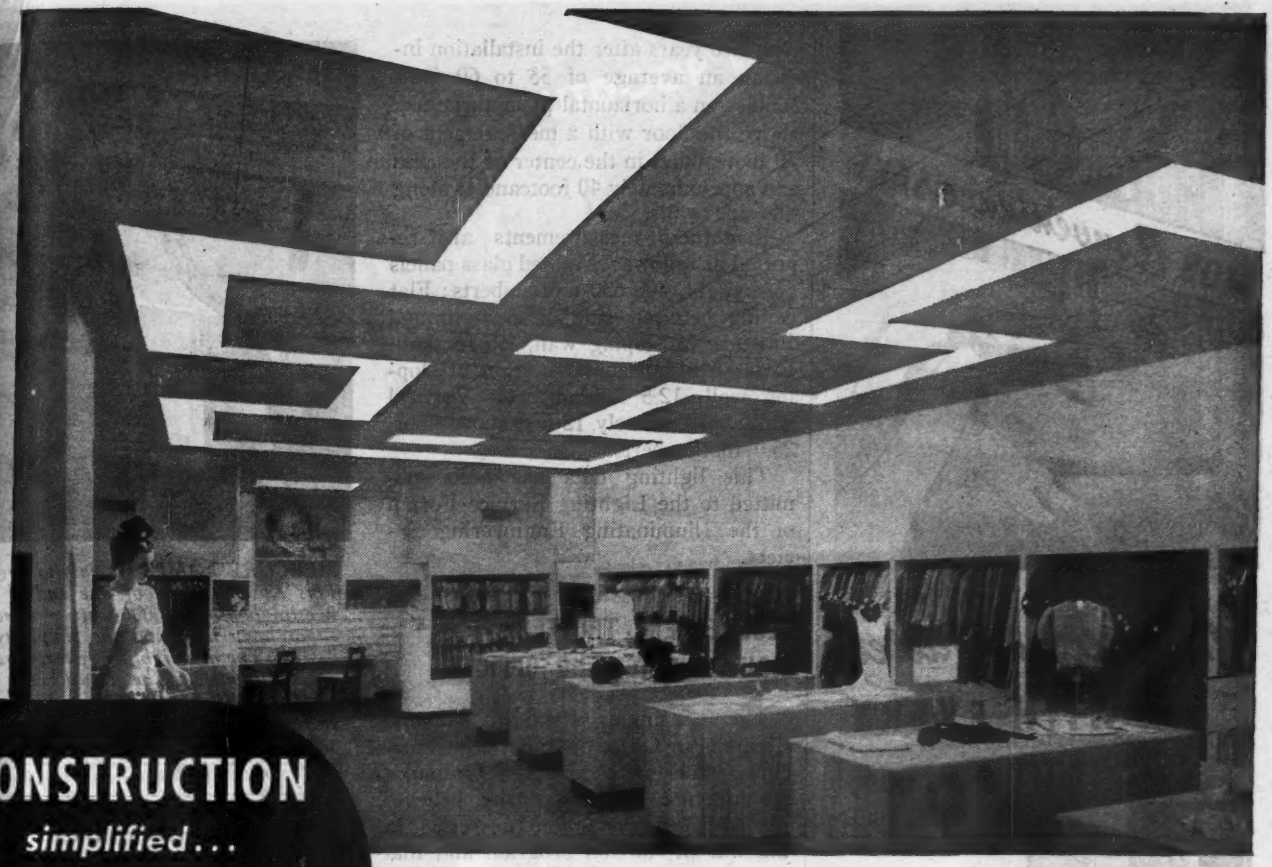

PERFORATED STRAP HANGERS FASTENED TO JOIST AND SUPPORTING 1½" X 3" CHANNELS ON 4'0" CENTERS
CONTINUOUS 1½" X 3" CHANNEL FROM WHICH ½" IRON PIPE HANGERS ARE SUSPENDED
REMOVABLE PLATE FOR OPERATION OF SOCKETS & BALLASTS FOR ACCESS TO EQUIPMENT
BALLASTS
ADJUSTABLE HANGER
SUSPENDED CEILING
4-40W FLUOR. LAMPS PER SECTION
GLASS PANELS

DETAIL of skylight hanging



PLAN VIEW showing location of skylight.

with channel iron and pipe hangers from the roof joists (see detail sketch). The design by the Architectural Lighting Company, Chicago, Illinois, includes the use of 40 panels 2 feet by 4 feet each containing four 40 watt white fluorescent lamps. The latter are spaced 5½ inches on center and are 4½ inches from center of tube to center of the glass panels. The reflector is made of metal and is coated with baked white enamel. The transmitting panels consist of clear ribbed glass known by the name "Skytex" as manufactured by the Blue Ridge Glass Corporation. The lighting system is maintained by means of a portable centerfold unit from below the ceiling. Walls and ceiling are painted an egg-shell white. Lighting measurements taken more



CONSTRUCTION
simplified...

INTERIORS
modernized...

by MILLER Fluorescent Troffer Lighting Systems

in factories, stores, offices, schools and public buildings

Miller Fluorescent Troffer lighting systems are engineered to lick planning and structural problems—as well as lighting problems.

That's why today's trend is to "plan the *building* around the *lighting*." It makes sense that way, for Miller Fluorescent Troffer lighting systems, in geometric patterns and lightstrips "by the mile," suggest new themes for interiors. So do their wide variety of glass and plastic lenses, plates, and metal or plastic grilles—designed to meet specific architectural and lighting requirements.

Behind this beauty, there is engineering versatility and practicability that is mighty refreshing. The Miller patented bracket is an example:

It ends laborious fitting of recessed lighting systems into hung ceilings. Now, these brackets are mounted from the structural ceiling and support both the ceiling and the Troffer lighting system.

All this, plus *lighting* qualities numbered among the outstanding engineering achievements of our time!

Miller distributors and field engineers are conveniently located to serve you.

Other Pluses of MILLER Fluorescent Troffer Lighting Systems:

Supports from structural ceiling reduced 50 to 75%.

•

Conduit and conduit fitting costs reduced up to 80%.

•

Wiring costs reduced up to 50%.

•

Permanent operation and maintenance economies.

THE MILLER COMPANY • MERIDEN, CONNECTICUT

ILLUMINATING DIVISION
Fluorescent, Incandescent Mercury Lighting Equipment

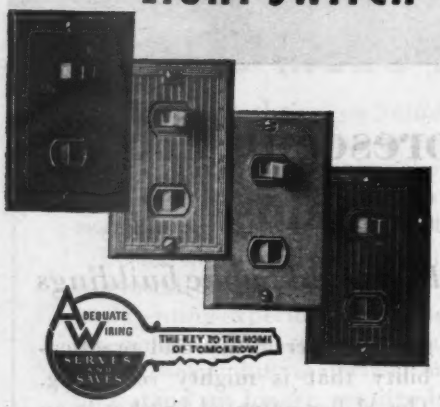
OIL GOODS DIVISION
Domestic Oil Burners and Liquid Fuel Devices

ROLLING MILL DIVISION
Phosphor Bronze and Brass in Sheets, Strips and Rolls

WAR CONTRACTS DIVISION
War Materiel

MILLER
SINCE 1844

Install an Outlet
WITH EVERY LIGHT SWITCH



This extra convenience costs only a few cents more. Then, if an outlet is needed, there it is — right at a convenient height. It takes up no extra space — Two (or even three) P&S-Despard devices can be installed in the same space required for one old style switch. For replacement work, the same single gang box can be used. If you are not already acquainted with the possibilities of Combination Wiring — the P&S-Despard way — send for a copy of our catalog.

Sold through Electrical Wholesalers.

P&S

PASS & SEYMOUR, INC.
SYRACUSE 9, N. Y.

than two years after the installation indicate an average of 55 to 60 footcandles on a horizontal plane three feet above the floor with a measurement of 70 footcandles in the center of the area and approximately 40 footcandles along the side walls.

Brightness measurements are reported as follows: Lighted glass panels of skylight, 400-650 footlamberts; Flat ceiling between side of skylight and juncture of sloping wall, 9.6 footlamberts; Mid-horizontal section of sloping wall, 12.5 footlamberts; Vertical wall approximately 12 feet above floor, 23.0 footlamberts.

This lighting data has been submitted to the Lighting Service Forum of the Illuminating Engineering Society.

FLUORESCENT TROFFERS LIGHT ENGINEERING OFFICES

The Cincinnati Planer Company, Cincinnati, Ohio produces vital machine tools necessary for Ordnance manufacture. This company believes that speed of production is essential in the war production program and that good quality, high intensity illumination helps to speed up production. When it planned the lighting for its combination engineering office and drafting room, it selected fluorescent deep troffers with baffles and equipped them with 40 watt daylight lamps to provide good lighting for quick and easy seeing. After 300 hours operation a check of the illumination results showed an average uniform intensity of 84 footcandles. Close spacing of units provided exceptionally uniform lighting. By using deep troffers, exposed lamps are shielded from view.

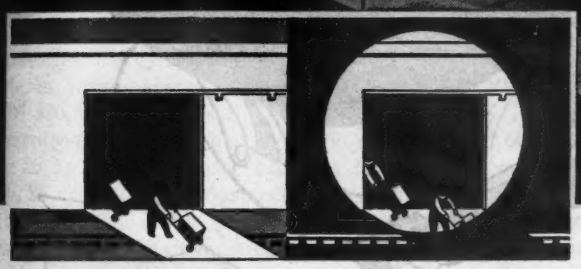
MERCURY LAMPS are easy to service. This close-up view of one end of the Westinghouse 3,000-watt mercury vapor lamp illustrates the simplicity of design. The new lighting system produces 35 footcandles. The catwalks in the Budd Field Plant in Bustleton, Pa., where this photo was taken, hang from curved white ceilings along eight bays which make up the plant.

Engineering Data

Area .....100 ft. by 38 ft., or 3800 sq. ft.
Ceiling Height....10 ft. 8 in.
Mounting .....Flush in ceiling
Spacing .....4 ft. by 6 ft.
No. Units.....160
Type .....Guth two-lamp 40 watt fluorescent deep troffer Cat. No. M-2366
Wattage .....4.25 w. per sq. ft.
Intensity .....84 footcandles average after 300 burning hours
Comments .....Data indicates coefficient of utilization of .58. Flush mounting of units presents neat appearance. Lamps are well shielded.

FLUORESCENT TROFFERS installed flush in ceiling provides easy seeing in engineering office and drafting room of Cincinnati Planer Co., Cincinnati, Ohio. Intensity is 84 footcandles wiring daylight lamps.

BOOST THE FIGURES FOR OUTDOOR WORK WITH Engineered Floodlighting



To bring hourly production at night nearer to daytime figures, look to your outdoor illumination—to floodlighting by Westinghouse.

Freight terminals require lighting intensities relatively higher than most outdoor applications, to permit reading of numbers and markings on crates. Special care must be taken to avoid shadows.

IN number of cars loaded . . . materials moved . . . stock piled . . . the volume of work depends on illumination. And Westinghouse lighting engineers, the pioneers in outdoor illumination, now offer the most modern methods and equipment for this type of lighting.

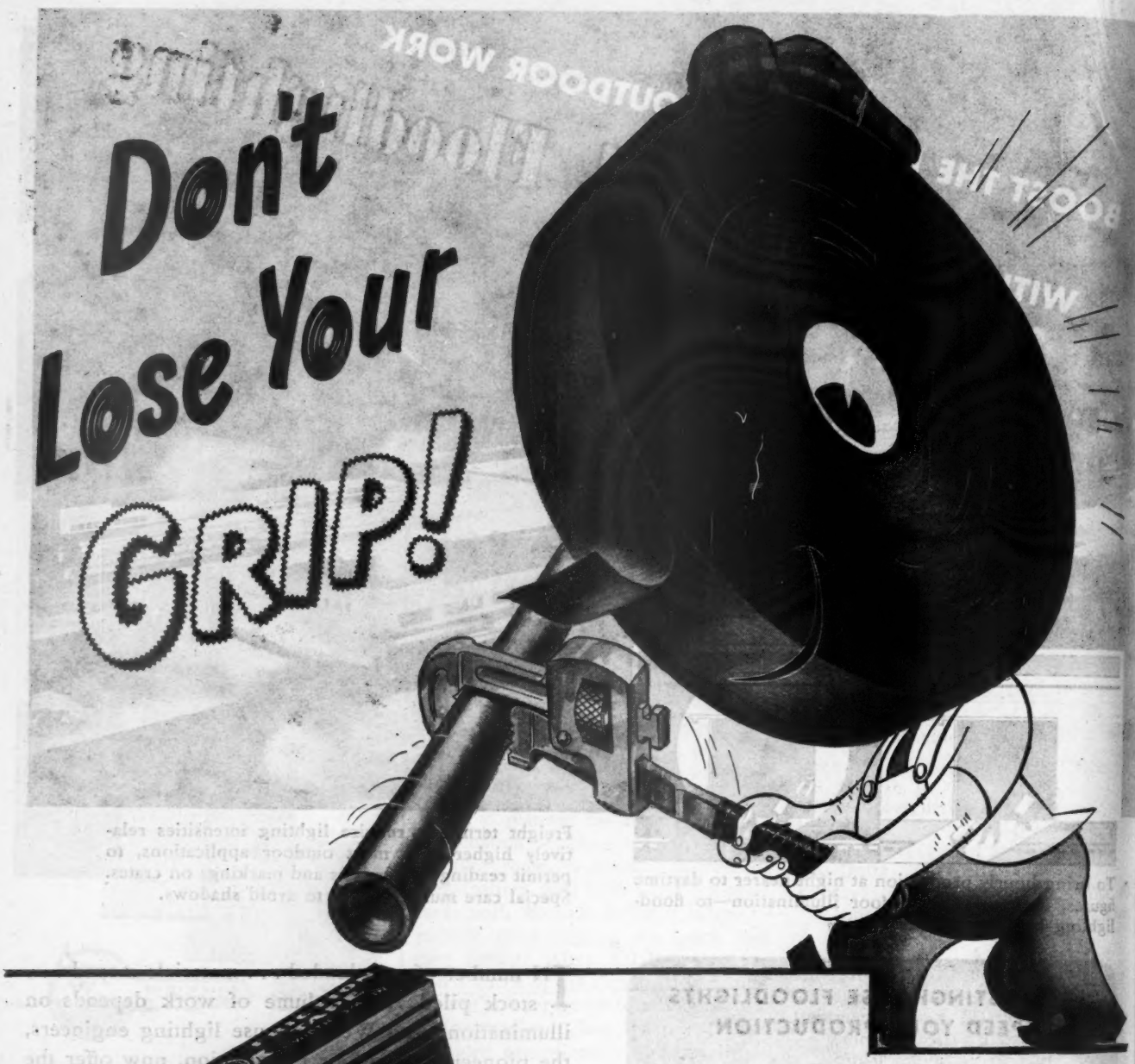
Floodlights in open or enclosed weatherproof designs are available for use with 100 to 2000-watt lamps.

The methods that originated with Westinghouse lighting engineers have proved highly efficient in furnishing light for outdoor work, for protection against peacetime intruders and for barriers against saboteurs. All this outdoor lighting equipment and the engineering experience needed to plan it, is available through Westinghouse Electric Supply Company offices and independent lighting distributors. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-04019

Westinghouse *Lighting* **EQUIPMENT**

AVAILABLE THROUGH 117 WESTINGHOUSE ELECTRIC SUPPLY COMPANY OFFICES AND INDEPENDENT DISTRIBUTORS

Don't Lose Your GRIP!



Safety Tip: When you're using a wrench on a "frozen" joint a good grip is a "must". Avoid accidents and wrap the handle of your wrench with U. S. Security Friction Tape. You'll work more safely... and faster and easier, too. There's no end to the ways Security Tape can help you—in plant, shop or home.

Play Safe — Use Security

Listen to "Science Looks Forward"—new series of talks by the great scientists of America—on the Philharmonic-Symphony program. CBS network, Sunday afternoons, 3:00 to 4:30 E.W.T.

UNITED STATES RUBBER COMPANY

1230 Sixth Ave., Rockefeller Center, New York 20, N. Y. • In Canada: Dominion Rubber Co. Ltd.

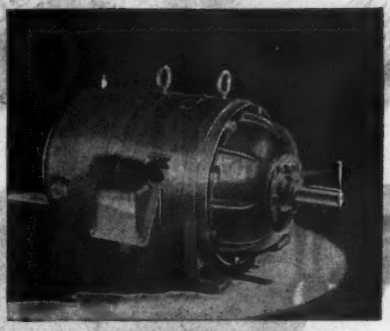
Serving Through Science

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.

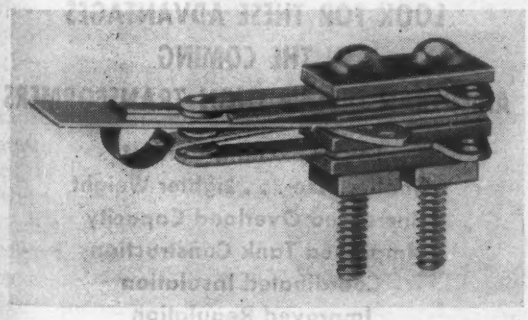
EQUIPMENT NEWS

Explosion-Proof Motor

A new Class I, Group C, explosion-proof motor, for atmospheres containing ethyl, and similar vapors, has been announced. It is recommended for use in chemical plants, hospitals, and research laboratories. Available in frame sizes 204-326, and in Types K (normal torque) and KG (high-starting-torque), the new motor is rated ½ hp. at 600 rpm. to 20 hp. at 3600 rpm., 110,208, 220/440, 550 volts, 60, 50, 25 cycles. The construction is essentially the same as the Class I, Group D motors, but a special flamepath is used at the shaft openings to cool the flame of internal explosions. Thermostats operate in conjunction with a magnetic controller to disconnect the motor at a predetermined temperature, but do not supplant regular overload relays. Other features include a cast-iron stator, a four-position cast-iron conduit box, and end shields of corrosion-resistant cast iron with reinforcing cooling ribs. General Electric Company, Schenectady 5, N. Y.



G-E EXPLOSION-PROOF MOTOR



ACRO SWITCH

Open Blade Switch

This small single pole open blade switch is designed for more compactness and long life. It is smaller in size and requires less operating pressure. The overall dimensions are approximately 2 11/32-in. by ⅝-in. by 33/64-in. Contact arrangements are for normally open, normally closed double throw circuits. Standard operating pressure at the end of the blade is 3 to 6 oz. Switch is rated at 15 amp., 115 volts a-c. Acro Electric Company, 1338 Superior Avenue, Cleveland 14, Ohio.

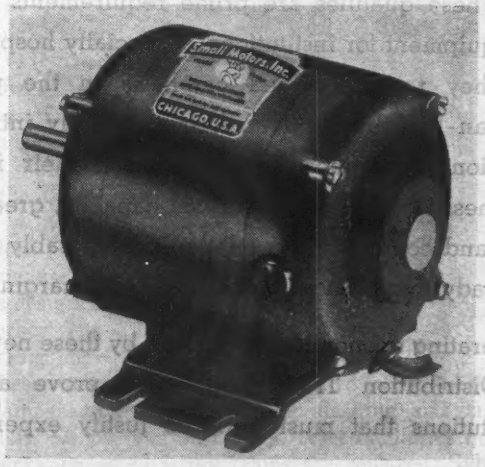
Cathode Ray Tubes

Cathode ray tubes for industrial apparatus and oscilloscopes for the study and inspection of electrical wave forms and the measurement of electrical voltages, currents, and frequencies are now available. Tubes for replacement in original equipment feature rugged construction, long life and uniform electrical characteristics. Available in standard 3 AP1, 3 BP1, 5 AP1, 5 BP1 and 5 HP1 RMA types. Sylvania Electric Products, Inc., Emporium, Pa.

SYLVANIA CATHODE RAY TUBE

Fractional Horsepower Motor

This new SM-4 fractional horsepower motor provides maximum power per ounce of weight and per inch of space for signal corps, aircraft and other military requirements and for a wide variety of industrial and domestic purposes. Housing is ventilated or completely enclosed. Made to order at speeds from 2000 to 10,000 r.p.m. with precision ball bearings and from 10,000 to 20,000 rpm. with oilless sleeve bearings. Governor controlled speed reduction may be built in to order. It is wound for any voltage from six to 25. Available from 1/50 to 1/10 hp. Small Motors, Inc., 1308 Elston Ave., Chicago 22 Ill.



FRACTIONAL HP. MOTOR

For Postwar Institutional Applications

Unfailing dependability and absolute safety have been associated with the AmerTran name for more than forty years. These qualities are prime requirements of electrical equipment for institutional, especially hospital, service. They receive added emphasis in the post-war AmerTran Distribution Transformers. Newly introduced production techniques have increased their inherent ruggedness. Their higher overload capacity, greater protection and coordinated insulation considerably improve the already exceedingly favorable safety margin.

The operating economies introduced by these new AmerTran Distribution Transformers will prove attractive to institutions that must perforce justify expenditures.

AMERICAN TRANSFORMER COMPANY, 178 Emmet St., Newark 5, N. J.

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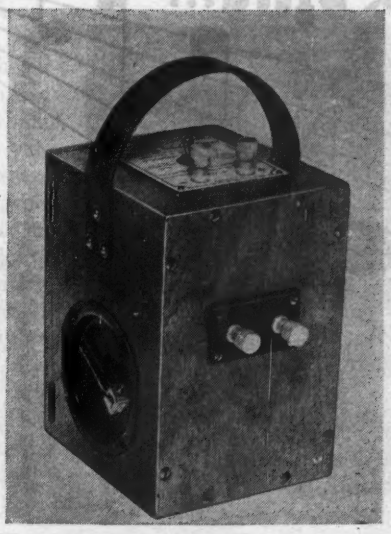
Smaller Size . . . Lighter Weight
Increased Overload Capacity
Improved Tank Construction
Coordinated Insulation
Improved Regulation
New Terminal Facilities

AMERTRAN

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

Circuit Tester

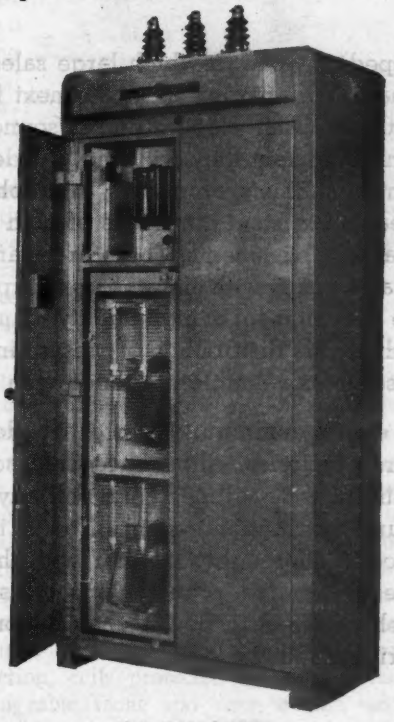
A new multipurpose circuit tester for acceptance tests of residential and commercial wiring has been announced. It is used for testing insulation between wires or from wires to the ground for defects or failures and the continuity of wires with audible positive answers at the point where the test is made. With a special indicator attachment it also determines the polarity of wires, visually. It operates on a hand cranked generator which develops 500 v., d-c. It contains no commutators, slip rings, gas tubes, calibrated meters, rheostats or adjustment knobs. Connecticut Telephone & Electric Division of Great American Industries, Inc., Meriden, Conn.



CONNECTICUT TELEPHONE TESTER

Auto-Switch Capacitors

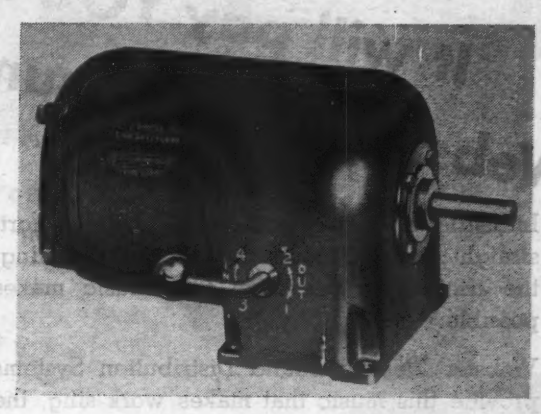
A new metal-enclosed, self-contained auto-switch capacitor, that automatically switches 180-kva, of capacitance on or off the feeder in response to voltage requirements, has been announced. Designed for improving the power factor of distribution circuits at periods of peak load, the capacitor is automatically connected in the circuit when increased load causes a drop in voltage, and is disconnected when voltage increases at light load. The equipment consists of a 180 kva., 2400 volt delta or 4160 volt 4-wire grounded Y, three-phase group of Pyranol capacitor units; a three-pole solenoid oil switch; automatic voltage control devices; and a potential transformer for supplying control power; as well as control potential for voltage-responsive equipments. Standard equipment is designed for response to line voltage, but current-responsive equipments are also available. The housing is designed for base or cross-arm mounting. Cover bushings of wet-process porcelain with clamp-terminal connectors provide for easy connection to the line. A hinged panel, containing all the devices for both automatic and manual control, is mounted in a protective compartment which separates the control from the power circuits.



G-E CAPACITOR

Gearshift Drive

A new addition to this line of selective 4-speed machine tool gearshift drives has been announced. This unit is designed to power machine tools and other equipment requiring motor capacities of 1 hp. or less. The unit is rated at ½ and ¾ hp. at 1200 rpm. and 1 hp. at 1800 rpm. The unit has an overall length of 18 inches including the shaft extension; the overall width, including terminal box and shifting lever is 12 inches, overall height is 9 inches. Known as Type R, it is designed for continuous operation, with ample overload capacity. A semi-enclosed, drip-proof, ball-bearing motor of either two or three phase, 50 or 60 cycle, 220, 440 or 550 volts is furnished as a standard integral part of unit. Type R is reversible in all speeds with the use of a reversing drum control. The ratios of Type R are 1 to 1, 1.33 to 1, 2 to 1 and 4 to 1. Shifting is done by means of a small lever which can be extended to any convenient position as required. The Lima Electric Motor Company, 2201 Findlay Road, Lima, Ohio.



LIMA GEARSHIFT DRIVE

Starters for Fluorescent Lamps

Two new manual reset type starters for 100 watt fluorescent lamps, designated as COP-6 and COP-64, have been announced. The COP-6 is a two-contact starter while the COP-64 is provided with four contacts for use in fixtures designed for another type of starting circuit. These starters are specially designed to cut out deactivated lamps and to eliminate lamp flashing and damage to ballasts. A pushbutton manual reset facilitates normal lamp operation when faulty lamps are replaced. Sylvania Electric Products, Inc., Salem, Mass.

SYLVANIA STARTER

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"Where Quality is a Responsibility and Fair Dealing an Obligation"

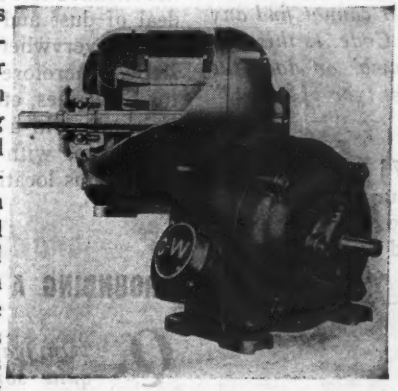
Insect Repellent Lamps

A new type of incandescent lamp has been announced. Lamp has a ceramic coating on the inside of the bulb which transmits only the yellow portion of the spectrum. Lamp is especially designed for use on porches, lawns, doorways or any location where people gather outdoors, as it lights the area but substantially eliminates the aggravation of insects. These lamps are effective because of the quality and quantity of light output. Available in 60 and 100 watts, 120 volts. Solar Electric Corporation, Warren, Pa.

SOLAR INSECT LAMP

Protected Type Motor

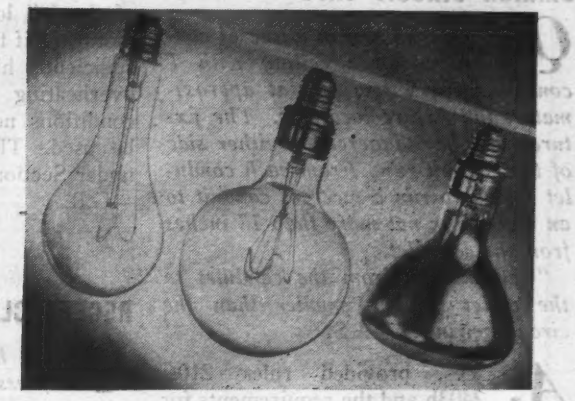
A new motor, combining the surplus capacity of the conventional open motor with protection against dripping liquid, falling metal chips and other foreign matter has been developed. It is rated 40° C. rise, full-load continuous duty, with a 15 percent service factor. These motors are available in sizes up to and including the 284 frame. Mounting dimensions conform to the standards of NEMA. There are no openings in the frame or shields above the horizontal center line. This, together with the shielded construction of the ventilating openings, makes protected type motors suitable for machine tool and similar applications where other types of enclosures have been required in the past. Centrifugal seals permit use of softer grease for better lubrication and longer bearing life. It uses the Alucast rotor construction, in which the bars, fans and end rings are cast in one operation from aluminum alloys. Other features of these motors include: heavy cast frame construction, coils protected by vinyl acetal insulation, interchangeable front and rear shields, and specially designed guides for directing cooling air over all surfaces. Crocker-Wheeler Division of Joshua Hendy Iron Works, Ampere, N. J.



CROCKER-WHEELER MOTOR

Infra-red Lamps

Seven new infra-red lamps, including four clear drying and three reflector drying types, have been announced, for many industrial heating services including plastic and metal preheating, baking, drying and dehydrating. The clear drying types provide a constant heat center length, which permits a change in oven temperature by substituting lamps of suitable wattage. Reflector changes are unnecessary. Lamps available in 125, 250, 375 and 500 watts, 115 volts. The reflector drying types offer flexible infra-red heating source for many drying and processing applications, including those in paint shops, foundries and other industries. New lamps of this type are for 125, 250 and 375 watts, 115 volts. The use of medium-skirted bases provided with most of these lamps eliminates loose bases during their extended life. This type of base is locked to the bulb mechanically and without the use of cement. Sylvania Electric Products, Inc., Salem, Mass.



SYLVANIA INFRA-RED LAMPS

Portable A-C Test Sets

Two portable a-c test sets, capable of supplying smooth test voltages from 0 to maximum rated voltages (2000 and 6000 volts), have been announced. Either set can operate from any 115-volt, 50 or 60 cycle outlet, and both have a capacity of 2000 volt-amperes. The units were developed for testing diesel-electric locomotives larger than 600 hp., but have many industrial testing applications such as generators, motors, motor parts, and appliances. Both sets consist of a dry-type step-up transformer, variable-voltage autotransformer, two indicating voltmeters, voltmeter selector switch, signal lamp, air circuit breaker with magnetic overload trip, and a supply switch. Two 15-ft. shielded test leads with insulated handles and 15-ft. supply cord with plug are also included. One of the indicating voltmeters is used to measure voltages up to half of the maximum rating, and the other up to full test voltages. These sets are housed in rectangular steel cases mounted on three-wheel trucks and grounded through the third conductor in the supply lead. Both sets are 19 inches high. The 2000 volt unit is 18 in. wide, 22 in. long, and the 6000 volt set is 15 by 25 inches. General Electric Company, Schenectady 5, N. Y.

G-E TEST SET

Answered by
F. N. M. SQUIRES
Chief Inspector
New York Board of Fire Underwriters
New York, N. Y.
and
GLENN ROWELL
Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

QUESTIONS ON THE CODE

BRANCH CIRCUIT TAPS

Q. *"I intend to run a line of conduit along a ceiling with T condulets every few feet at approximately the fixture locations. The fixtures will be staggered on either side of the conduit run. From each condulet I plan to run a piece of conduit to an outlet box not more than 18 inches from the condulet.*

"Can the tap from the condulet to the outlet box be smaller than the circuit wiring?"—A.S.

A. Yes, provided rules 2106, 2403b and the requirements for "conductors" under the various branch circuit rules, such as 2142, 2152, 2162 and 2172 and of course, the carrying capacities of conductors, are followed.

All of this means, that on a 15 ampere branch circuit, a No. 16 or No. 18 fixture wire could be tapped in the condulet to the No. 14 branch circuit conductor and run for not over 18 inches to the fixture outlet. The fixture wire of course, will have to be large enough to carry the fixture load.

On a 20 amp., 25 amp. or 35 amp. branch circuit, the tap should not be smaller than No. 14, but must be large enough for the load.

On a 50 amp. branch circuit, the tap must be at least No. 12.

For an individual branch circuit supplying only a single outlet or appliance, but not motors nor motor driven appliances, the tap need not be of any specific size, but shall be of sufficient capacity to carry the load which it supplies.—F.N.M.S.

MOTOR PROTECTION

Q. *"Is it really necessary to provide all fractional horsepower electric motors over $\frac{1}{8}$ horsepower that are automatically controlled with an integral protective device?"*—H.C.P.

A. No. Such motors may be protected by the circuit overcurrent protective devices providing they are set for not more than 140 percent of the full load current rating of the motor, or if the motor windings have a sufficiently high impedance to prevent overheating even under locked rotor conditions no special protection need be used. This ruling may be found under Section 4322c of the N. E. Code. —G.R.

RECEPTACLES IN FLOORS

Q. *"I have been under the impression that an ordinary duplex convenience outlet cannot be placed in a floor, but I cannot find any reference to it in the Code. Is this just another 'rule of thumb' or does the Code require a special type of outlet?"* —L.A.

A. Section 4173 contains the answer to your problem. This section requires the use of special floor boxes approved for the purpose for the enclosure of a receptable located in the floor.—G.R.

WIRING A FOUNDRY

Q. *"There is a factory in town which makes castings. Somebody left something laying around and caused a fire. Most of the wiring was damaged. The ceiling is of wood construction and the sidewalls are brick and cement blocks. The building was wired in BX cable. Is it O.K. to rewire in BX and to use ordinary outlet boxes and drop cords?"*—B.U.

A. The question here is largely one of temperatures and not one of mechanical injury.

In many foundries the ceilings are high and the ventilation is good and the heat from the forges is carried out of the buildings by proper stacks. In such places where the temperature does not at any time approach 120° F., the use of armored cable (BX) would be acceptable provided it can be installed so as not to be subject to mechanical injury. Naturally the use of ordinary outlet boxes and drop cords would be all right.

But some foundries are in small buildings really ill fitted for foundry use, with low ceilings and poor ventilation. Here temperatures are quite apt to run, at least in the upper part of the room, such as at the ceiling, above the temperature for rubber insulation (120° F.) and therefore armored cable should not be used. Also in such a place, the cable as well as drop cords and unprotected lamps, would be subject to mechanical injury.

Most foundries are rough places and not inclined to be very clean. A great deal of dust and dirt fills the air and lodges everywhere it can find a place to settle. Therefore lighting fixtures, motors, switches, etc., would be better off if installed in a dust tight manner in compliance with the rules for Class 2 Hazardous locations.—F.N.M.S.

GROUNDING A WELL MOTOR

Q. *"On many farms the well is quite some distance from the distribution center, so we have made a practice of grounding the well motor to the well casing. Just recently a claim has been filed against us by a former customer who claims that two of his cattle were killed by electrocution. An investigation indicated that the motor burned out and shorted, and current followed the water piping into the barn. The original grounding wire was still in place and the motor circuit had proper fuse protection. Can you explain why the current flowing to ground through the well casing failed to open the fuses?"*—P.H.

A. While this is not a question of Code, it is one which is worthy of an answer as there have been several similar cases which have come to light in recent years. Tests conducted on one farm with a 200 foot drilled well indicated a resistance to ground on the well casing of considerably more than 25 ohms. This high resistance

may have been caused by pipe dope or corrosion on the threads at the couplings, or the casing may have been grouted in to prevent contamination entering the well. Therefore, unless an actual resistance test can be made, the well casing should not be used as a grounding electrode. If possible, the motor should be insulated or isolated from the pump and any piping entering buildings housing livestock. The motor frame should be grounded with approved ground electrodes and provided with proper overcurrent, overheating running protection. If the motor is to be housed within a pit covered with straw during cold weather, the protective device should be mounted adjacent to or be part of the motor controller. If the motor is located within a building and is always accessible, a protective device integral with the motor may be depended upon. In no case should a well motor be dependent upon the overcurrent devices protecting the circuit even though it is manually controlled and of less than one horsepower.

To answer your question as to why the fuses failed to open, lets assume you installed a ½ horsepower 230 volt single phase motor with no running protection and placed 15 ampere overcurrent devices in the circuit. If the resistance to earth on the well casing were 25 ohms, only 9.2 amperes would flow.—G.R.

COLD CATHODE LIGHTING

Q. *"I recently came across a cold cathode show case lighting installation consisting of a regular 15,000 volt sign transformer connected up with 5,000 volt ignition cable. A single tube was properly supported the length of the case, but the return conductor was encased in loom and stapled to the inside surface of the wooden front panel. Apparently sign men are making these installations without too much regard for human lives. Will the next edition of the Code prohibit the use of high voltage currents for inside lighting?"*—O.O.

A. As this is being written, the next edition of the Code has been indefinitely postponed so it is impossible to know just what provisions it may contain, when printed, concerning cold cathode lighting. I believe, however, that this practice of using high voltage cold cathode lighting is a temporary situation stimulated by critical material shortage and the War Production Board. In other words, merchants are buying lighting

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Bench wiring by Jean Wheeling, of the Curtiss-Wright Corporation Columbus, Ohio

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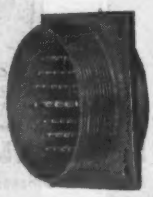
Write for condensed Cannon Catalog. It gives you a general introduction to the Cannon line. Address Department A-231, Cannon Electric Development Co., 3209 Humboldt St., Los Angeles 31, Calif... ***Below is pictured a wall mounting, typical of the famous Cannon AN line of plugs.***

CANNON ELECTRIC

Cannon Electric Development Company
Los Angeles 31, California

Canadian Factory and Engineering Office: Cannon Electric Company, Limited, Toronto, Canada



REPRESENTATIVES IN PRINCIPAL CITIES—CONSULT YOUR LOCAL TELEPHONE BOOK

installations made up of this type of equipment because they cannot obtain anything else without proper priority. The sign men are caught without any signs to service by the government decree forbidding electricity for such use, so they are anxious for work and some have become interested in using up their sign transformers and tubing by wiring show cases. No doubt this condition will cease to exist as soon as materials are again released from government controls. In the meantime it will be necessary for the electrical inspectors to watch for these installations and forbid the use of those cases which appear to be hazardous.—G.R.

FARM WIRING

Q. *"In serving two or more farm buildings, where a separate service entrance, including fused disconnecting switch, is installed at each building, what are the code requirements covering installation of a main service entrance (with meter) on a 'yard pole' with overhead feeders to the various buildings to be served?*

"Not clear to us is the statement in the Code (Par. 2306) '. . . . . the conductors running from one building to another shall not be considered as service conductors.' If these conductors are not to be considered as service conductors, how are they considered?

"It has occurred to us that an installation of this kind might not need an over-current device or even an externally-operable switch at the main service entrance location.

"Could service entrance cable be used to run down, and back up, the pole to the meter container?"—A.U.

A. The Code in Section 2306 is dealing with a group of buildings ("more than one building under single management") and suppose primarily that the service from the supply line enters the "one" building in which building is a master service supplying this building and the other buildings.

The rules (Sections 2351 and 2371) require that where this service enters this first building, there shall be a disconnection means (2351) and over-current protection (2371). These comprise the service.

After passing through this master service the conductors have been provided with a means for disconnection and with over-current protection.

At this point the "service" stops and the interior wiring begins. The conductors, then, become feeders or circuit wires.

The conductors to other buildings

from this first building, are not service wires but are the feeders to the other buildings and as they have been given the required protection, do not need to be as severely restricted as do service wires. For instance, the control switch does not have to be in the building served, but may be in the first building.

Of course it would be permissible to not use a master service in the first building. Then there would have to be a service equipment in this building for this building itself and also a service equipment in each building served and all of the service wires and service equipment would have to comply with Article 230 which would include the requirement for externally operable switches.

The above rulings are without regard to metering equipment and a meter or meters could be cut in where desired. For instance a meter could be cut in on the main service line whether a master service is used or not, or a separate meter could be placed in each building and either ahead or after the service equipment. Also Section 2307d permits tapping in for meters, and of course service entrance cable could be used for this.

Another arrangement which is permissible and which could be used is to have the service equipment located on the "yard pole". This equipment would have to be within reach (readily accessible) and would have to provide proper protection to the feeder or feeders run to the other buildings as well as to provide a disconnecting means. In this case the wires from the pole to the buildings are considered as feeders as they are protected against overcurrent.—F. N. M. S.

REPLACING CONDUCTORS WITH LARGER COPPER

Q. *"We have just finished increasing the feeder capacity in a small war plant which had some type SN wire installed in conduit. It was found necessary to replace some of the SN conductors with larger copper and considerable trouble resulted when the old conductors were pulled out. The insulation had apparently partially melted within the conduit in several different places, especially in those runs extending through the boiler room. Now that the conductors are of proper size for the load they carry, is there any likelihood of this condition repeating itself?"—F.W.*

A. The N. E. Code limits the use of Type SN or Type T, as it is to be known, to an ambient tem-

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750 to 1500 watts, Type L-68	GEA-4333
Area, open porcelain enamel	
300 to 1500 watts (Type L-45) (Type L-46)	GEA-2877B
Handy, sheet aluminum	
200 watts, Type L-66	GEA-4346

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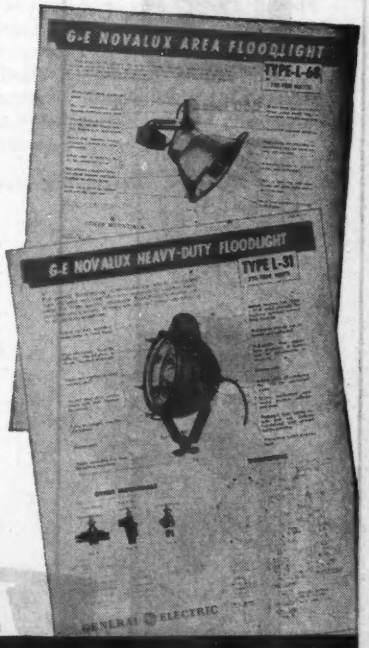

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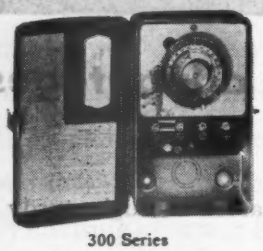

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perature of not more than 140 degrees Fahrenheit. You failed to indicate the average temperature conditions in which this installation was made and inasmuch as either overload or high ambient temperature or a combination might result in the condition you describe, it is impossible to say whether or not the insulation will soften on the new installation. However, it is not unlikely that the actual ambient temperature near the ceiling of the boiler room may reach or even exceed the 140 degrees, and if such is the case, Type SN conductors should not have been used. You will note upon referring to Table 1 on page 301 of the N.E. Code that Type SN conductors can carry only 58 percent of their rated capacity at an ambient temperature of 122 degrees Fahrenheit and only 41 percent at 131 degrees.—G.R.

GENERATOR INSTALLATION

Q. *"We are installing a Diesel driven generator in a sawmill that previously has obtained power from a high line. Due to the arrangement of buildings and topography of the yard, it would be most economical if we could extend the service runs from the power house through a large mill work building to serve the sawmill and other buildings on the premises. We have been told that this is contrary to the Code. Is that true?"*—L.C.M.

A. Electric service cannot supply one building through another unless such buildings are under single occupancy or management. This ruling may be found under Section 2303 of the N. E. Code. Inasmuch as the buildings with which you are concerned are obviously under single management and occupancy, the Code would not prohibit the service conductors being extended through one building to serve another.—G.R.

FARM SERVICE ENTRANCE

Q. *"For a single phase, 115, 230 volt, grounded neutral, farm service entrance, could No. 4 service entrance cable (RP wire) be used with 100 amp. fused type switch, having fuses of 70 amps. capacity?*

"We have had some questions asked covering the above and one wireman insists that when a fusible switch of 100 amps. capacity is used, the service entrance cable must be of the same capacity as the switch rating, regard-

less of the amount of load to be served or the size of fuse used. We contend that Paragraph 2305-a applies in this case.
All references are to the 1940 Code."
—S. D. K.

A. Yes! No. 4 RP wire has an allowable carrying capacity of over 70 amps. and therefore it is permissible to protect it with 70 amp. fuses. As the 70 amp. fuse would not go into a 60 ampere block, it would be necessary to use a 100 ampere block and Section 2357 requires that the service switch shall not have a rating less than that of the fuseholder in series with it but it does not prohibit the use of a larger switch. Therefore No. 4 service entrance cable with type RP wire could be used with a 100 amp. service switch and fused at 70 amperes, provided the load as computed with Section 2203 would not exceed 70 amperes. This in accordance with Section 2305a.—F. N. M. S.

MOTOR CONTROLLER FOR PROTECTION

Q. *"May I use the heaters of a motor controller as the overcurrent protection for electric heaters?"*—A.C.

A. No. While a motor controller may serve as running protection for a motor, if it complies with Section 4329 of the Code, it may not fulfill all of the requirements for the protection of an appliance which is not motor driven. A motor controller may not provide proper short circuit protection for a heater and it might not open all of the ungrounded legs of the circuit. Fuses or circuit breakers would probably be more reliable.—F.N.M.S.

NEW NISA DIRECTOR R. E. Ward (left), Raleigh, N. C. (Region 4) gets into a between-session huddle with secretary H. E. Grant of Nashville, Tenn., at a recent meeting of NISA Board of Directors in Chicago.

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requires no contact with the rotating element and is unique for measuring speed of totally enclosed machines and other equipment where the end of the shaft is not accessible. The only mechanism is a set of accurately tuned steel reeds which vibrate by resonance according to the speed of the machine with which the instrument is held in contact.

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IN THE NEWS

WPB Adjusts War Controls

One-Front war basis has permitted revocation and adjustment of many War Production Board controls and regulations. Remaining controls are necessary to protect military production and essential war-supporting activities in war against Japan.

The military defeat of Germany has been accomplished. We are now in a one-front war against Japan. The need of production for the war against Japan must continue to have first call upon the nation's resources.

Many of the all-out, two-front war controls and regulations of the War Production Board have already been revoked. Others are under careful and intensive study for revocation or relaxation. These actions by WPB are not always fully understood or correctly interpreted. A review of some of these actions may be of assistance in appraising early reconversion opportunities and in eliminating possible confusion and misinterpretation.

The primary goal and function of WPB remains the prompt filling of all military needs and the maintenance of a sound war-supporting economy for a speedy conclusion of the war against Japan. It is their expressed intention, however, to relax controls wherever that can be done safely. Should shortages develop, or other conditions arise, which make it necessary to tighten individual controls, that will also be done. Their control system is flexible and geared for adjustment to meet current conditions and realities.

Production of munitions and war material, though reduced, still absorbs a large proportion of the available manpower and materials. There continues to be shortages of many items, such as textiles, lumber and other forest products, leather, containers, tires and rubber products, and some metals.

Order L-41, which controls construction, will be retained but will be progressively relaxed as resources become available. Lack of lumber is expected to continue to affect the relaxation of construction controls, it was explained soon after V-E Day by John L. Haynes, Director, Construction Bureau, and Chairman, CPO (Committee on Period One) Committee, Construction and Construction Controls. Direct military requirements for lumber in Europe continue to increase during the period of redeployment of men and material. At the same time, the stepped-up tempo of the Pacific war is intensifying the military demand for lumber and plywood in that theatre. 1945's military and civilian requirements total approximately 40 billion board feet, with the present rate of output totalling not over 29½ billion board feet. Lumber is now placed almost on a par with ammunition as a combat essential. Lumber is also essential for civilian construction. The military de-

"You must try to remember you are out of the Army now, Joe, and you're not stringing wire under fire."

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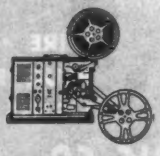

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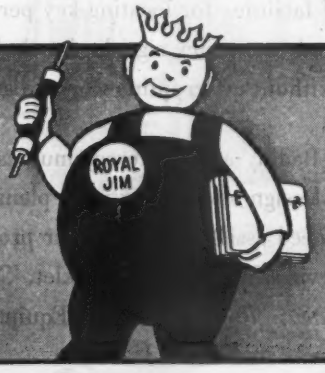

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mands for lumber and lumber products must be met. Civilian construction work can only go forward to the extent that substitutes for lumber can be used and to the extent that lumber production is increased beyond military requirements.

As of V-E Day, estimates of additional labor needed in woods and sawmill jobs to bring production up to necessary levels totalled more than 125,000 additional men. Labor released from war plants when cutbacks are made, or otherwise available, is urgently needed in the lumber industry.

It is expected that Order L-41 will be amended at an early date to increase dollar exemption limits to four or five times present limits. It is also expected that standards for authorizing larger projects will be relaxed to an extent that will permit approval of projects that contribute to large scale future employment and to satisfy other highly essential needs.

Four specific actions being taken by the War Production Board will assist in reconversion preparations and minimum resumption of civilian production. These actions are outlined below.

1. Approximately one-half of the 420 limitation, conservation and other orders, which were in effect April 1, 1945, are being revoked. Others are expected to be revoked or relaxed within the next few months.

2. "Open-ending" of the Controlled Materials Plan becomes effective July 1, 1945. This will permit the delivery of steel, copper and aluminum without CMP allotments, on and after that date, where delivery can be made without interference with authorized CMP orders. Buyers may place orders now for delivery after July 1, 1945, under this provision.

3. Most "rating floors" are being removed from controls and regulations. This will permit the placing of unrated orders, where such production and delivery will not interfere with rated orders.

4. Assistance will be given to small manufacturers, including veterans and new enterprises, who produce less than $50,000 per quarter. This assistance will be in the form of an AA-4 preference rating, and the right to place secondary (Z-3) CMP orders for steel, copper and aluminum. The period for this assistance begins July 1, 1945 when CMP is "open-ended", and ends December 31, 1945. It is designed to help small manufacturers to get their fair share of production materials.

A simplified priorities system is expected to replace the existing system. However, the existing priorities, according to present plans, will remain in effect for the remainder of 1945. The new simplified system will be designed to give first priority to military production, and second priority to essential civilian production. It will probably be limited to these two classifications only.

WPB has already taken action to assist industry in obtaining needed machine tools, equipment and construction to prevent delay in reconversion. Direction 2 to Priorities Regulation No. 24 provides for the assignment of a preference rating for the procurement of machine tools and other capital equipment under specified conditions. The issuance of Direction 5 to Order L-41 covers reconversion con-

truction projects. Approval and assignment of preference rating on WPB-617 applications for construction of any project that will not interfere with the war effort and which meets other stated conditions, will be made pursuant to this regulation.

Revocation of a specific order does not necessarily mean that immediate resumption of civilian production of the affected product may be begun. It clears the way for such production when facilities, materials and manpower become available. Relaxation of controls is intended to be carried out in such fashion as to minimize dislocation and confusion in the transition from the production of war goods to civilian goods. Industry must continue to comply with all WPB orders and regulations as long as they remain in effect, if these advantages are to be realized.

The "open-ending" of CMP is being made, effective July 1, 1945, to permit the delivery of any controlled materials (steel, copper, aluminum) which may be available beyond war and essential war-supporting requirements. Manufacturers of priority products will continue to receive controlled materials allotments. Thus, CMP will continue to give "positive assistance" for essential production, which will protect such production from the scrambles for materials for non-war production.

For the remainder of the second quarter, and until July 1, 1945, deliveries of controlled materials can be made only on authorized CMP orders. However, unrated orders may be placed now for delivery after July 1 under the new "open-end" arrangement. This permission gives no assurance that an unrated order can be filled. Deliveries on unrated orders may not be possible for some time, particularly on some items now in short supply, such as sheet steel and fine copper wire.

Priorities Regulation No. 13 has been revised to permit the movement of surplus steel, copper, and aluminum on an unrated basis, for uses no longer restricted by WPB regulations.

Inventory limitations are being retained to help prevent preemption or hoarding of scarce supplies.

The release of a WPB control gives no assurance that all of the materials required to produce a product will be available. It does, however, permit a manufacturer to utilize his ingenuity to make substitutions and to take advantage of idle or excess stocks in order to avoid the use of scarce materials.

With the revocation of certain WPB orders which in the past had prohibited sale and delivery on unrated orders of the products affected by these orders, many have interpreted the revocation as authority to ship rated or unrated orders without regard for sequence, according to WPB officials. Priorities Regulation No. 1 is still in effect, and prohibits the sale or delivery of an unrated order for the same commodity unless all of the rated orders are filled, it was explained.

Some of the conservation and limitation orders which affect the construction and electrical industries are highlighted below.

M-9-c, M-9-c-1, M-9-c-2, M-9-c-4. *Copper and Copper Products. Revoked.*

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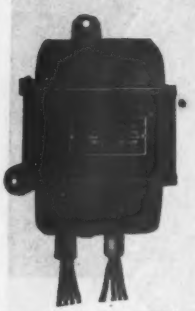

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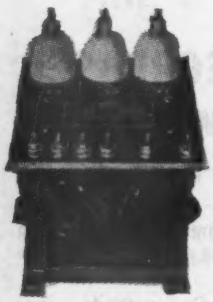

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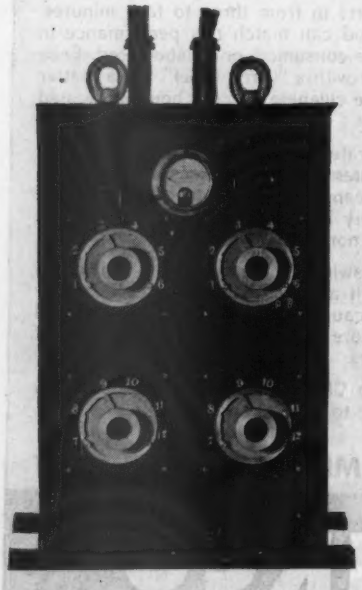

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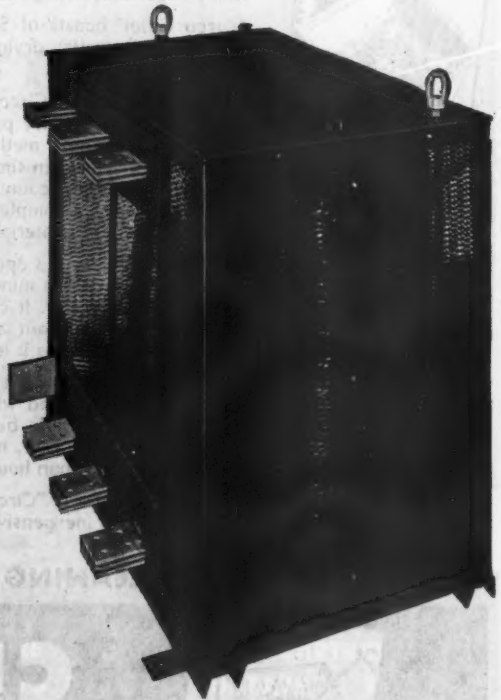

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Revocation permits use of copper for many purposes heretofore prohibited. Refined copper remains in short supply and will, with ingot, scrap, and other raw materials, continue to be allocated under Copper Order M-9. This in turn will limit the amount of controlled materials (strip, rod, tube, wire and castings) that may be produced for civilian orders. Fine copper wire is in short supply, and expected to remain inadequate to meet the demand for sometime.

M-21-a. *Alloy Iron and Alloy Steel. Revoked.*

M-126. *Iron and Steel. Revoked.* Revocation of this order permits use of iron and steel for manufacture of all products previously prohibited by the order. Stainless steel is still in tight supply.

L-29. *Metal Signs. Revoked.* Revocation permits metal to be used in production of signs, either illuminated or non-illuminated. Sheet steel is in very tight supply, however, and available supply will continue to be absorbed by rated orders.

L-78. *Fluorescent Lighting Fixtures. Revoked.* Lack of ballasts, the chief essential component in these fixtures, will prevent immediate expansion of production very far beyond present levels. Ballasts will continue in short supply, due to heavy military demands for radio and radar equipment.

L-161. *Electric Fuses. Revoked.* Certain types of fuses are in tight supply with delayed deliveries.

L-216. Schedule 1. *Universal Portable Electric Tools. Revoked.*

L-221. *Integral Motors and Generators. Revoked.* Bottlenecks on components may be expected. Large backlog of high priority orders now exists.

L-235. *Airport Lighting Equipment. Revoked.* Major requirements are for the military and for Civil Aeronautics Authority.

L-250. *Electric Motor Controllers. Revoked.*

L-273. *Busways. Revoked.* Unrated orders may now be placed.

L-315. *Safety Switches. Revoked.* Unrated orders may now be placed.

L-327. *Aircraft Lighting Equipment. Revoked.* Very little demand is expected beyond direct military requirements.

Availability of Electrical Products

Delays in deliveries of from one and one-half to two months may be expected on standard wiring devices; of three to four months on specialized wiring devices; of three to four months on rigid conduit; and of five to six months on thin wall conduit.

Fuses under 2500 volts, of renewable type, are available for immediate delivery. One time and plug type fuses are subject to from two to three months delay.

Porcelain outlet boxes are available for immediate delivery. Metal outlet boxes are subject to delayed deliveries.

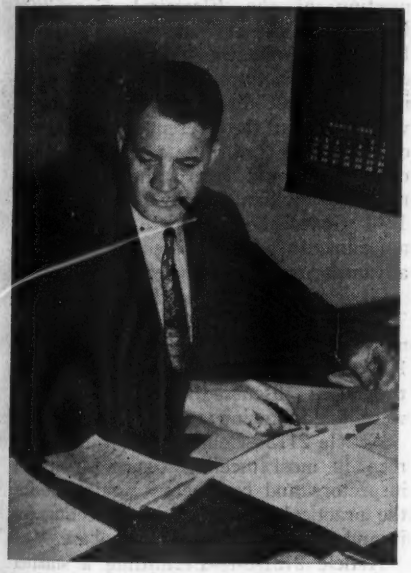
Explosion-proof conduit fittings and fixtures are subject to from five to six months delay in delivery.

Lighting fixtures and equipment are generally available for approved con-

struction. Fluorescent lighting fixtures are subject to delays in delivery, due primarily to the lack of ballasts which are in short supply. Explosion-proof and vapor-proof lighting fixtures may also be slow in delivery.

No. 10 and smaller copper wire, and armored conductors, are in tight supply, causing delays in delivery.

Motor demand exceeds supply on small size a-c motors. New military orders are heavy and the situation is critical. Backlogs on current production rate are eleven months for fractional; 13 months for integral single phase; and 16 months for integral polyphase up to 20 hp. Manpower shortages and material difficulties are the problems. Factory stocks are practically non-existent, although dealers are authorized some stock. Surplus and reconditioned motors are obtainable through Reconstruction Finance Corporation and motor repair shops.



ESTIMATOR-ENGINEER, Chester E. Edgar, Electric Power Equipment Co., Columbus, Ohio, is an ardent booster of flexible distribution systems. When figuring jobs, he firmly contends there are no estimating short cuts.

ZERVAS LEAVES INDIANAPOLIS LEAGUE

Walter O. Zervas resigned as managing director of the Electric League of Indianapolis, Inc., on June 1 to take a position with the American Iron & Steel Institute in New York City. In his new position he will direct the research and promotional activities of the Institute in the uses of steel for electrical systems.

Mr. Zervas, an engineering graduate of the University of Wisconsin in 1922, has had 23 years of experience in electrical organization and promotional activities. For nearly five years after graduation he was commercial field survey supervisor for the Wisconsin Telephone Company. He then took over the managership of the Electrical League of Milwaukee for some 10 years. Prior to his selection as managing director of the Indianapolis League in June 1940, he was

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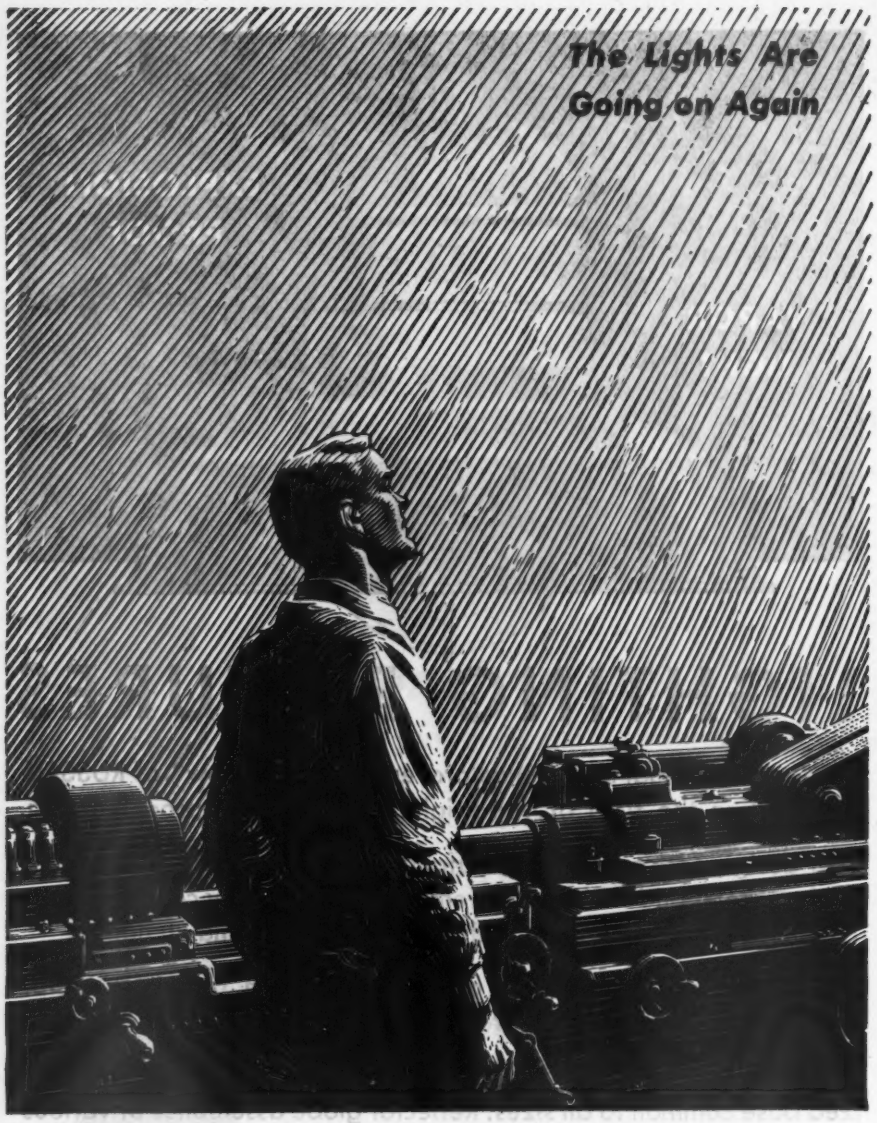

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in charge of load building for the Rural Electrification Administration in Wisconsin.

During his League association he was prominent in the activities of the International Association of Electrical Leagues. He carries with him the well wishes of his host of friends and associates in the electrical field.

As yet, no successor has been selected to fill the position left vacant by Mr. Zervas' resignation.

IAEI CHAPTERS DISCUSS CODE CHANGE

Evaluating the opinion expressed at three significant annual meetings of chapters of the International Assn. of Electrical Inspectors, held in Denver, Salt Lake City and Great Falls, Mont., last month, the cancellation of the scheduled meeting of the Electrical Committee, NFPA, for the revision of the National Electrical Code, was decided unpopular. Although strictly speaking such a meeting would not directly contribute to the war effort at the present time, its cancellation will contribute to confusion and controversy and retard the forthcoming return to civilian activity because the old 1940 Code, shot through with interim amendments, will not be equivalent to the advances made in the electrical industry.

At each of the meetings Victor H. Tousley, secretary IAEI, reviewed the more important proposed changes to the 1940 Code and invited comment. Among the items discussed in these meetings were the following:

Article 2112—Common neutral. Utility men in most meetings were for it but inspectors and contractors against it for the practical difficulties in inspecting for it and the possibility of its abuse.

Article 2121-c-1—Permitting a smaller neutral on a range load. Opinion was that no smaller than a No. 8 be permitted for a range load in any case, just for mechanical strength.

Article 2405—Requirement of a trip coil on each leg of a three-phase system was felt to be needed, particularly in rural areas served from three-phase systems where interruption of one phase might not open the entire circuit and motors would single phase and burn up.

Article 2524—The wording was considered confusing but the idea of a separate ground on the load side in a building housing live stock seemed to be favored.

Article 2559—Grounding the frame of a range to the grounding circuit conductors has been practiced generally in that area for many years without harm and so this change was not objectionable.

Article 2351—Permitting six subdivisions of load, was held to be an arbitrary and unnecessary limitation. There was considerable opinion in favor of 10 subdivisions of load.

Article 310—There was no protest over the proposed wire changes, but the question of what size neutral would be the minimum, a No. 7 or No. 9, and also of what would be the minimum size service wire was felt to need clarification.

Article 4125-g—Prohibiting the use of plug cap and receptacle for connection of lighting fixtures was also objected to on the ground that the method is used universally and is an aid to maintenance.

Article 4156—The limitation of 600 volts would prohibit use of new long slim fluorescent lamps in domestic occupancies. It was felt some limitation was needed but just what was not clear.

Article 500—Felt to be too complicated in its rewritten form and that it would increase inspection difficulties rather than aid them.

Although these chapter meetings were chiefly to discuss Code changes some other features were introduced, especially at the Denver and Salt Lake City meetings. Both of these had talks on tubular high voltage lighting; in Denver by John Ford, Electric Products Consolidated, in Salt Lake City by Tom Young, Young Sign Co. Lester Johnson, General Electric Co., Salt Lake City, spoke to the Denver meeting on low voltage fluorescent, and to the Montana meeting on underfloor ducts and cellular steel flooring. James S. Mahan, Chicago, told of the Type-S fuse situation and also spoke on membership at the three meetings.

Ralph Johnson, Sturgeon Electric Co., Denver contractors, told the Denver meeting the need for engineered plans to get real adequacy of wiring. Charles Farrah, Denver assistant chief electrical inspector described the Denver Code schools.

H. G. Ufer, western superintendent, Underwriters Laboratories, Inc., Los Angeles, told of revised standards for testing and rating switches, at both Utah and Montana chapters. W. A. Cyr, *Electrical West*, debunked the dream home of the future at all three sessions.

J. Hyde Stayner, Utah Power & Light, chairman of the IAEI committee on elimination of inadequate wiring in the postwar period, presented his committee's report to the Utah meeting. A. E. Fleming, senior electrical engineer, Headquarters Ninth Service Command, gave an interesting paper on the elimination of static electricity hazards in army hospital operating rooms.

Officers elected at the three chapter meetings were: *Rocky Mountain Chapter*—D. G. Mulligan, Denver, succeeding V. D. Markham, Colorado Springs, as chairman; Leo Kelsey, Cheyenne, 1st vice-chairman; Carl Simon, Denver, second vice-chairman and V. C. Moulton, Denver, secretary-treasurer.

Utah Chapter—Harold Morr, Board of Fire Underwriters of the Pacific, Salt Lake City, chairman, succeeding D. J. Wolters, chief electrical inspector, Salt Lake City, as chairman, the latter being elected secretary-treasurer; Ray Powell, Nephi, 1st vice-chairman; and C. F. Grant, Utah Power & Light, second vice-chairman.

Montana Chapter—George Blend, electrical inspector, Army air base, Great Falls, chairman, succeeding Bruce Shavere, REA inspector, Lewiston; K. L. Chrysler, city engineer, Billings, 1st vice-chairman; Ralph Grant, city inspector, Havre, second vice-chairman; and James G. Clune, Montana Power Co., Chinook, secretary-treasurer.

"We make 50% savings on labor and cut material spoilage 20% with our two GREENLEE Hydraulic Benders," says George W. Hecht, Sup't., Collier Electric Co., Denver, Colorado. "On one job alone, time and material savings totaled about $600.00."

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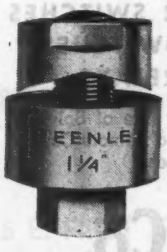

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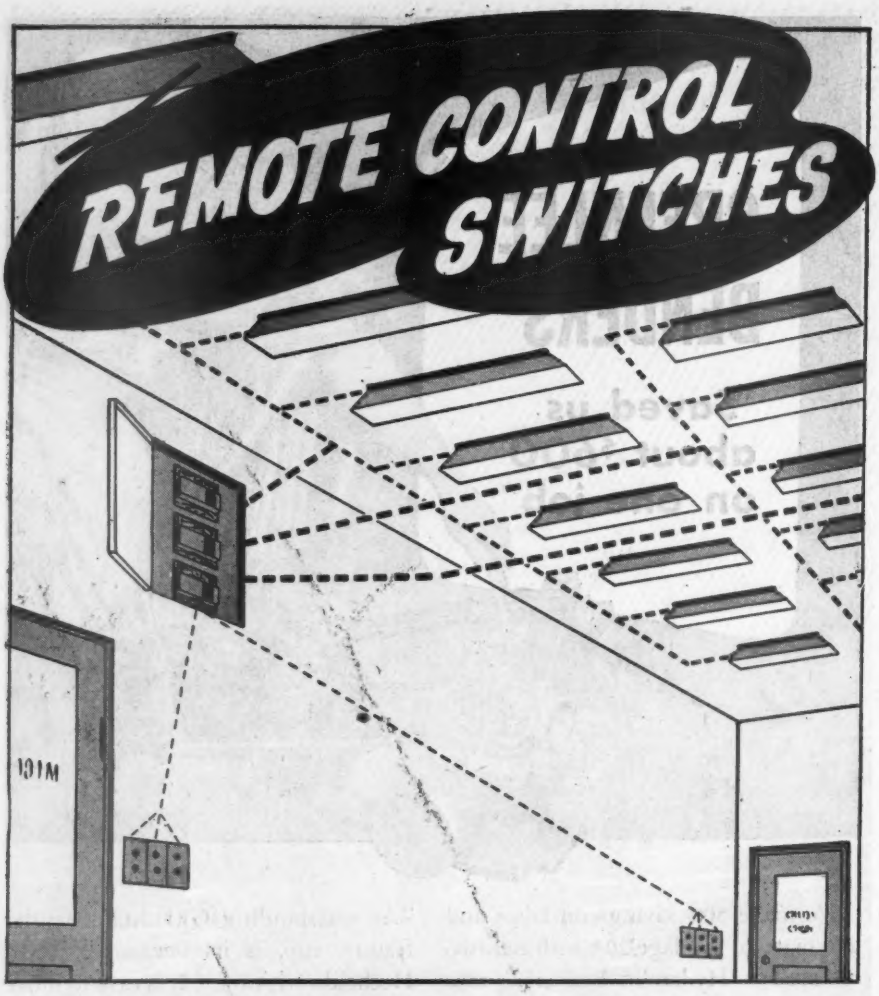

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COPPER WIRE RELAXED

Methods by which electricians, electrical contractors and certain types of repair shops may obtain copper wire have been outlined by the War Production Board.

The amounts of wire that may be purchased by electricians, electrical contractors and repairmen doing work on electrical appliances, refrigerators and commercial refrigeration and radios is explained in Controlled Materials Plan Regulation 9A. Where more wire is needed in a calendar quarter for the kinds of work permitted, WPB said, a repairman must fill out a CMP-4B application for the additional quantity needed.

Repairmen doing work primarily of an industrial nature, such as generator and motor rewinders, may write to WPB in Washington for special authorization to purchase larger amounts of copper wire.

Since only a limited amount of wire may be purchased under CMP-9A, an electrician or electrical contractor is advised to determine first if a business or activity for which he is to do a maintenance or repair job is listed in the schedules of CMP-5 or 5A. If so, it may be possible to use the customer's maintenance, repair and operating supplies allotment symbol to purchase the wire needed, as described in paragraph (g-1) of CMP-5 and (h) (2) of CMP-5A.

Businesses or activities not listed in the schedules of those regulations, such as hotels, office buildings, restaurants and laundries, may not use the MRO allotment symbol. However, businesses not listed may file a WPB-541 application with the nearest WPB field office for the right to use that symbol. If granted, the procedures of paragraphs (g-1) and (h) (2) of CMP-5 and CMP-5A, respectively, will apply.

Reports from the field, WPB said, indicate that some confusion appears to exist as to what constitutes maintenance and repair. Wiring of new homes, buildings, and garages, and most wiring extensions or additions are classified as "construction" and are not maintenance or repair work, and the wire necessary cannot be obtained under CMP-9A.

In addition, such construction is governed by WPB Order L-41. Certain dollar limits are set by this order, below which WPB approval is not necessary for the job to be done. Where the construction job exceeds this dollar limit, an authorization must be obtained. Usually, that authorization assigns an allotment symbol to be used to obtain necessary wire. L-41 sets forth the application that must be filed and the place of filing. Ordinarily, the person owning the building, not the repairman, must file.

An electrician or electrical contractor who has a farm wiring job, which is not maintenance or repair, and which falls within the "no WPB approval required" limits of L-41, should urge his customer to apply to the War County Committee for an allotment of copper wire for the job, WPB said.

For farm jobs needing only a few feet of wire, no priority is necessary. The wire may be bought at retail stores.

WPB REVOKES COPPER ORDERS

The War Production Board has announced revocation of orders. M-9-c, M-9-c-1 M-9-c-2 and M-9-c-4, which restricted the manufacture, delivery and installation of many copper products. This action was in line with WPB policy to relax controls as rapidly as possible after V-E Day, the agency said.

The revocations will permit the use of copper for many purposes heretofore prohibited. It was pointed out, however, that until July 1 manufacturers will have to rely mainly on copper from surplus inventories. After July 1, under the revised Controlled Materials Plan procedure, mills will be permitted to deliver copper controlled materials on orders not bearing CMP symbols, provided that such deliveries do not delay the production and delivery of military and essential civilian orders. Such orders, WPB said, may be placed immediately for delivery after July 1.

WPB cautioned that in no sense do the revocations mean that copper is available once more in unlimited supply for civilian production. Refined copper remains in short supply and will, with ingot, scrap, and other copper raw materials, continue to be allocated under copper Order M-9. This in turn will limit the amount of controlled materials (strip, rod, tube, wire and castings) that may be produced for civilian orders.

It was emphasized by WPB that there are other orders and regulations that limit or prohibit the use of copper, and that compliance with such orders will continue to be required.

WPB REPORTS BALLAST PRODUCTION STILL LIMITED

If production of fluorescent lighting fixtures should be further curtailed because of lack of ballasts, additional controls on end uses of the fixtures may be necessary, members of the Fluorescent Lighting Fixtures Industry Advisory Committee stated at their recent meeting, as reported by the War Production Board.

The present production rate of ballasts permits production of sufficient fluorescent lighting fixtures to take care of essentials needs, WPB officials and committee members agreed. However, if the quantity of ballasts available should be curtailed or demand for the fixtures should expand, additional distribution controls would have to be imposed, they said.

Specialty transformers for radio equipment are made with the same plant facilities and use the same components as ballasts for fluorescent lighting fixtures. Military requirements for the transformers are high and are expected to remain high even after the end of hostilities in Europe, a representative of the Radio and Radar Division told the committee.

Stepped up military requirements for transformers and numerous factors limiting ballast and transformer production—such as steel mill schedules, copper wire supply, and manpower shortages—indicate

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that the ballast supply situation may become more acute, WPB officials said.

Suggestions for channeling fixtures to most essential uses if such action becomes necessary included further restrictions on blanket MRO ratings and on fluorescent lighting in approved construction projects. It was the concensus of the committee that, in view of the dependence of fluorescent lighting fixture production on ballasts, WPB should exert every effort to maintain an effective distribution of these components.

WIRING STANDARDS APPROACHING COMPLETION

Excellent progress is being made in revising the standards for adequate wiring in homes and on farms.

The sub-committee doing the job met on April 4th and reviewed in detail the latest drafts. These are being revised without delay in accordance with the findings of the sub-committee for submission to the Industry Committee which will review and subsequently present them to the ten national organizations sponsoring the project.

The whole group of standards will be in several sections and it is proposed that the two sections now being revised be entitled, respectively, "Handbook of Residential Wiring Design" and "Handbook of Farmstead Wiring Design". H. R. Stevenson of Detroit Edison Company and Morris Lloyd of Niagara, Lockport and Ontario Power Company are, respectively, chairmen of the Technical Sub-Committee of the Industry Committee responsible for the detail work.

In its presently recommended form and arrangement the Residential Handbook differs considerably from the original one. It will be more convenient to use and easier to apply because of the clear distinction drawn between requirements and recommendations.

The Farmstead Wiring Standard will be the outcome of extensive investigation

ELECTRONIC CONTROL EXPERTS at panel session of recent Chicago War Production Conference were (L to R) G. W. Spellmire, General Electric Co., Chicago (welders); Dr. L. T. Rader, Director of Dept. of E. E. Illinois Institute of Technology (motors); and L. B. LeVesconte, Armour Research Foundation, Chicago (chairman).

and much study. As a pioneering effort it will be divided into two parts—one covering wiring for light and power in all types of farm buildings, while the other discusses the outside distribution system on the farm. It gives promise of being a most important contribution to the forwarding of more complete electrification of our farms.

LIMITATION ORDER L-78 REVOKED

Limitation Order L-78, governing manufacture and distribution of fluorescent lighting fixtures, has been revoked by the War Production Board. Other orders and regulations that affect manufacture and distribution of the fixtures remain in force, however, WPB pointed out.

L-78 was originally issued in April, 1942, to effect savings in steel, copper, mercury and other materials critical at that time. The order, which at first prohibited the manufacture of all fluorescent lighting fixtures except for essential uses, as defined, was amended as the material supply situation changed.

Ballasts, the chief essential component in these fixtures, will continue to be in short supply, owing to heavy military demand for radio and radar equipment, WPB officials said. Lack of ballasts will prevent immediate expansion of production very far beyond present levels, they pointed out.

ORDER L-41 MAY BE RELAXED

Some control over construction activities will have to be retained after V-E Day because of shortages of certain building materials, particularly lumber, the Hardware Industry Advisory Committee was informed at its recent meeting, the War Production Board has reported.

John L. Haynes, director of WPB's Construction Bureau, reviewed the construction outlook as it will affect the hardware industry and said that some relaxation of Order L-41 undoubtedly will be possible. However, no definite statement as to what form the relaxations will take can be made at present. Possibly, restrictions on repair work may be made less rigid, and ceilings on cost of construction that may be undertaken without WPB authorization may be raised, he said.

Committee members were in general agreement that the hardware simplification order L-236 should be revoked as soon as possible. It was the concensus that if the order were revoked the industry would continue to manufacture urgently needed standard items and would not embark on the production of "fancy" items.

The supply situation for gray iron castings is tight, and no improvement is expected for some time to come, a repre-

IN most industries there are definite standards of leadership. In many industries these standards are known, accepted, even taken for granted by middleman and public.

Previous to 1935 the only accepted signalling instrument for the modern home was the common door bell. With no pre-established standards of research, engineering, construction or performance of electric door chimes to work by, Rittenhouse did much to lay the foundation upon which the standards of the industry have been built.

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sentative of the Steel Division told the committee. Any improvement is dependent on cutbacks in military programs, he added. The industry was urged to explore the possibility of using aluminum castings, which are not in short supply.

NHA RECEIVES ADDITIONAL APPROPRIATION

An additional appropriation of $66,000,000 for construction of publicly financed war housing has been made available to the National Housing Agency in the First Deficiency Appropriation Bill of 1945, recently signed by President Truman.

The funds will be used to erect temporary housing in a number of communities where it is still necessary for war plants to recruit labor from the outside to meet production programs.

It is anticipated that the funds will provide about 20,000 family units; 1,600 trailers, and 6,000 dormitory accommodations.

A provision of the act requires that projects in which the Army has a paramount interest shall first be jointly authorized in writing by the Secretary of War and the Director of the Bureau of the Budget. The same provision is made where the Navy's interest is paramount except that the written authorization will come from the Secretary of the Navy.

WPB AND LABOR TO DISCUSS RECONVERSION PROBLEMS

Plans for intensive consultation with labor on all aspects of reconversion problems that will arise during Period I—the period between the defeat of Germany and the defeat of Japan—have been announced by the War Production Board.

During the 60-day period beginning May 7, some 300 representatives of labor in all fields of American industry will be called to Washington for a series of meetings on reconversion problems. They will include representatives of unions in manufacturing operations in all parts of the nation.

These meetings are being called under the provisions of WPB Directive 40, issued March 5, 1945, which provides procedures for clearance and consultation on cutbacks. They are expected to develop recommendations for equitable distribution of the burden of cutbacks in the affected industries, WPB said, and any proposals on policies outside the jurisdiction of WPB will be made available to the Office of the Director of War Mobilization and Reconversion.

The first of these meetings was with the Brass Mill Labor Advisory Committee, then a meeting of the Radio and Radar Labor Advisory Committee.

A series of meetings with labor representatives from the consumer durable goods field will be scheduled immediately after. These will include committees from the dry cell battery, domestic mechanical

refrigerator, domestic laundry equipment, vacuum cleaner, sewing machine and wood furniture industries.

During the remainder of the 60-day period meetings are being arranged for labor representatives from the following industries: machine tools, aluminum, construction machinery, farm equipment, general industrial equipment, office machinery, plumbing and heating, transportation equipment, building materials, lead and zinc mining and smelting, fractional horsepower motors and lumber and lumber products.

Questions to be considered involve problems of seniority, returning war veterans, availability of tool makers and millwrights for restoring machine tools to location, what will happen to women war workers and, problems in rehabilitation of plants so far as unions are concerned.

INDIANAPOLIS DEALERS STATE CODE OF ETHICS

Anticipating the many postwar problems that will face appliance dealers once the shooting stops and the merchandise begins to roll off the production lines, the members of the Appliance Distributors Division of the Electric League of Indianapolis recently took steps to curb, voluntarily, any cut-throat practices that might develop after the war.

They drafted a Postwar Code of Ethics for adoption by each individual distributor as he saw fit. In essence, the policy stated below will be that pursued by every member distributor in the future, it is reported.

"Statement of Policy"

"Appliance distributors, in approaching the problem of the postwar period, realize that to protect the principles of Free Enterprise is fundamental; and to the end that improper business practices which tend to impede its effective operation may be removed, the following basic policies will be adhered to by this company:

First: That we will sell our products only to authorized dealers. An authorized dealer is defined herewith as a retailer who carries a representative stock, who maintains a sales or display room, one who truthfully represents his merchandise in his advertising, who renders necessary service to the customer, and who observes the principles of fair competition.

Second: We will not compete in consumer sales with retail stores.

Third: We will not sell our products to another employer for resale to his employees.

Fourth: We will not sell to our own employees any product other than our own.

It is generally recognized that distributors will be faced with important new problems in the years immediately following the war. We believe therefore, that whatever harmful practices existed in the past, should be eliminated now. This "Pledge" on our part, is evidence of our full appreciation of the situation and

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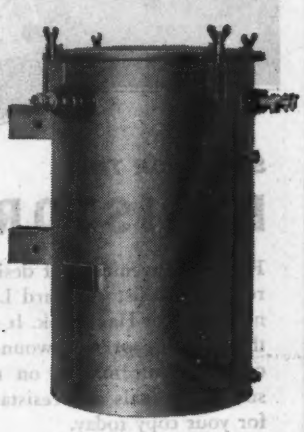

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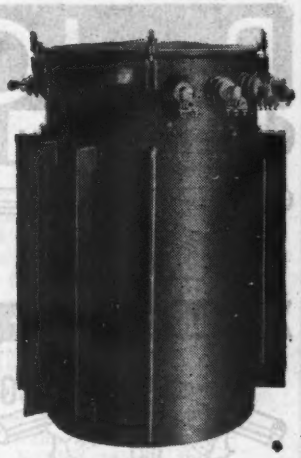

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our desire to do our part in the building of a harmonious and healthy industry relationship between manufacturer, distributor and dealer for the future."

RECONVERSION AND POSTWAR PROBLEMS STUDIED BY SMALL BUSINESS COMMITTEE

One hour following the formal announcement of V-E Day, the Senate Small Business Committee of which Senator James E. Murray is chairman, started an examination to determine what steps should be taken to aid the highly important construction industry with its reconversion and postwar problems.

Secretary of Commerce Henry A. Wallace, testifying before the committee, outlined a four-fold program which he indicated should be the objectives of both the construction industry and Government during the coming transition period. His program is as follows:

1. The rapid expansion of construction activity as soon as resources can be released.

2. Maintenance of a continuing volume of construction at from 15 to 20 billion dollars a year with a view to maintaining full employment in the industry and in the economy.

3. More construction for more persons and industries at less cost, which he summarized in the motto "More goods for more people at less cost."

4. Stabilization of construction activity in such manner as to give the industry maximum effectiveness in preventing business depressions without preventing normal growth.

Secretary Wallace said that a program to achieve these objectives would be of great aid to small business, pointing out that according to the 1939 Census 87 percent of the 215,000 concerns engaged in contract construction did an annual volume of business of less than $25,000.

In discussing the question of full employment in the industry, Secretary Wallace said: "There is also the question of

NISA ADMINISTRATIVE problems are discussed in a lobby-session by director Wm. J. Wheeler, New York City (Region 2) and new president Wm. H. Braunlich, Pittsburgh (right) at Directors meeting in Chicago.

whether a volume of 15 to 20 billion dollars, continuing year after year, can be handled on a sustained yield basis without the over-building which inevitably leads to collapse. We shall want to give very careful consideration to this problem over the next several years."

Speaking of housing, Secretary Wallace said: "The industry faces the transition from war production with a large backlog of accumulated demand." He indicated that a total of 16 to 18 million new dwelling units would be needed during the next 10 years to achieve a minimum goal of decency in housing. Housing construction at this level would be roughly double the highest annual rate achieved in the best pre-war year.

Responsibilities of the Department of Commerce for achieving the four broad objectives in connection with construction, according to the Secretary, are as follows:

1. Development of better factual information and the interpretation of this information for the use of the industry and as a guide to public policy.

2. Purposeful analysis of the industry with the relation to the objectives and in terms of industry requirements and business and government policies.

3. Work with the industry to make this information and analysis most useful to it and to stimulate and encourage its activities aimed at these objectives.

4. Promotion of technological developments leading to better structures and lower costs.

WPB TO HELP ON NEEDED CIVILIAN ITEMS

J. A. Krug, Chairman of the War Production Board, has announced that WPB field offices are now ready to assist persons who need bottleneck machine tools, capital equipment or minor construction necessary to support a minimum practical production rate of needed civilian items.

However, Mr. Krug again emphasized that the first duty of the country still is to supply war materials for as long as they are needed by our fighting forces and that all requests for assistance in reconversion preparations will be very carefully screened.

The steps which the agency have taken for the minimum resumption of civilian production are:

(1) The issuance of Direction 5 to Order L-41, covering construction projects for reconversion. WPB is prepared to approve WPB-617 applications for the construction of, and assign preference ratings to, any project that will not interfere with the war effort and which satisfies the following criteria:

a. It is necessary to do the construction or acquire the facilities before the civilian production can be started, and postponement of construction would result in unduly delaying production when restrictions are removed.

b. The construction and facilities are a relatively minor addition to or alteration of the applicant's plant.

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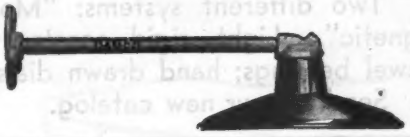

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Available in either porcelain enamel or synthetic enamel finish, green outside, white inside. Type A neck for 2¼" shade holder. Made in 4 sizes for 60, 100, 150 and 200 watt lamps.

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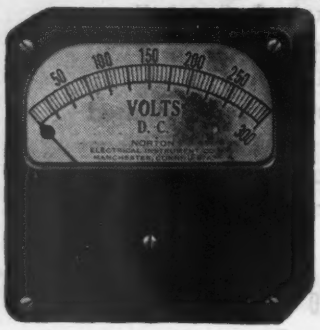

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BELL SOUND SYSTEMS, INC.

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Export Office: 4900 Euclid Ave., Cleveland 3, Ohio

c. The construction and facilities are no more than what is needed for production at the minimum economic rate.

d. The construction and facilities are not for replacement or improvement of existing facilities, which are adequate though less efficient.

e. The product that will be manufactured must generally be one that is needed for the civilian economy.

If the application is approved, the applicant will be assigned a CMP allotment symbol and an AA-3 preference rating, which is the treatment usually accorded to approved construction.

(2) The issuance of Direction 2 to Priorities Regulation No. 24 provides for the assignment of an AA-3 rating for the procurement of machine tools and other capital equipment, provided the application satisfies similar criteria to these for construction applications. WPB pointed out that if capital equipment acquired under PR-24 can be installed under Direction 2 to L-41 (generally speaking, if no new buildings or additions are required) no application under L-41 is required.

All such applications for reconversion preparation must be filed in WPB field offices, and manufacturers who can qualify are urged to file immediately. The applications for construction must be plainly marked "Reconversion Preparation".

PAINT NOW CRITICAL

The War Production Board has announced a critical paint situation which has developed from the resin shortage which made Conservation Order M-387 necessary, and from other shortages of raw materials for paint. The scarcity of labor in the woods is the basic cause of the resin shortage. Even if both V-E and V-J Days should come in 1945, this condition will not be substantially relieved before 1946, WPB said, because resin production is seasonal, chiefly April to September. It will become more serious as reconversion permits greater production of civilian items. At the present time there are four major uses for resin —paper and paperboard cartons, soap, synthetic rubber, and industrial paints, with many other minor uses.

Paints for industrial application require synthetic resins in order to obtain quick dry, hardness, and durability. Alkyd resins generally produce the best types of white baking enamels, but they are extremely scarce and are only approved for military purposes. Other resins including ureas, phenolics, and maleics are not as restricted, but because of the resin shortage, quantities for civilian uses are drastically limited, WPB reported. The urea and maleic types have been used extensively by the lighting industry for a baked white enamel on reflectors.

In making plans for the immediate future, industry should consider this situation very seriously and investigate possible substitutes for white enamel such as porcelain enamel, aluminum, or diffusing plastics or glass.

SPOT AUTHORIZATION PLAN RESTORED

Another important step has been taken by WPB in order to adjust its policies and controls to the changing military procurement programs of the Army Air Forces and other military agencies, J. A. Krug, Chairman of the War Production Board, has announced.

This action restores the complete operation of the Spot Authorization Plan for approving civilian production through district and regional offices of WPB, Mr. Krug said. Such authorizations have been severely restricted in critical labor areas since fall, when the pressure of battlefield experience on war production made it impossible to use certain resources for civilian production since they were still needed for war production, he added.

Civilian production under the spot authorization procedure may now be authorized in Group I and II labor areas without the unanimous consent of the Production Urgency Committee for the particular locality, Mr. Krug said.

This action represents a modification of the December 1, 1944, joint Army, Navy, War Manpower Commission and WPB agreement, which was designed to restrict civilian production authorizations under the spot program in critical labor areas to instances where all concerned parties—both military and civilian—agreed that there would be no interference with military and essential civilian output.

This new policy places all areas throughout the country on the same footing as far as spot authorizations are concerned, and means that procedures for obtaining permission to produce civilian goods in Group I and II areas will be the same as in Group III and IV and unclassified areas.

Controlled materials—copper, steel and aluminum—will not be available in the immediate future, according to WPB officials, for deferred allotments under the spot authorization procedure. However, attention is called to the fact that idle and excess stocks may be used for the production of civilian type goods under the procedure, and these items may be used immediately for authorized production.

In addition, it was pointed out, the Controlled Materials Plan will be "open-

D. J. WOLTERS, Salt Lake City, turns the gavel over to new chairman Harold Morr.

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AVOID OVERHEATING AND CURRENT LOSSES WITH

PORCELAIN

"Beat the heat" with Porcelain Protected Wiring—the coolest operating of all wiring systems! With Porcelain knob-and-tube wiring *all* wires are surrounded by air which quickly dissipates any load-generated heat, thereby enabling the system to carry greater loads as recognized by NEC. Not only is money saved by preventing current losses, but additional protection against fire losses is also provided.

For utmost safety, economy and durability—wire the Porcelain way! Non-metallic wiring and non-metallic wiring materials get the OK of your community's efficient Electrical Inspector—the man with the answers to all questions about fire prevention. Write for wiring manual.

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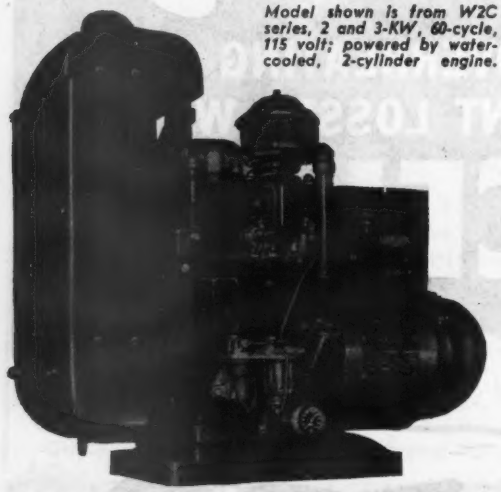
Wire Today for Tomorrow's Load

ELECTRICITY
For Any Job—Anywhere

Reliable, economical electric service for electrical contracting projects anywhere, anytime, with an Onan Electric Generating Plant. From the 65 basic models, the right plant for any job or application, large or small, can be selected.

Driven by Onan built, 4-cycle gasoline engines, these power plants are of single-unit, compact design and sturdy construction. Suitable for all mobile, stationary or emergency service.



Model shown is from W2C series, 2 and 3-KW, 60-cycle, 115 volt; powered by water-cooled, 2-cylinder engine.

ELECTRIC PLANTS Onan

Models range from 350 to 35,000 watts. A. C. types from 115 to 660 volts; 50, 60, 180 cycles, single or three-phase; 400, 500, and 800 cycle, single phase; also special frequencies. D. C. types range from 6 to 4000 volts. Dual voltage types, available. Write for engineering assistance or detailed literature.

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Three sources to choose from—all under capable and experienced management . . . Our representatives are located in key cities throughout the nation.

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THE NATION'S LARGEST EXCLUSIVE MANUFACTURERS OF QUALITY COMMUTATORS

ended" when conditions permit, with the result that the spot procedure will become less important as a mechanism for authorizing civilian goods output.

Mr. Krug pointed out that WPB has already taken action to grant priority assistance to those industries which converted to war production during the war and which have major tooling and facility problems in getting ready for peacetime production.

Mr. Krug emphasized that the relaxation of War Production Board controls will be very gradual in view of the urgent necessity of maintaining all military production needed to complete the victory in Europe on schedule and keeping pace with accelerated military operations in the Pacific. Because of these heavy demands the supply situation for textiles, leather, lumber, forest products, rubber products, many chemicals and certain other strategic materials will continue extremely short, and this situation may continue throughout the Japanese war.

Mr. Krug said that the War Production Board program would be in accordance with the board's established policy of relaxing wartime controls as soon as possible consistent with maintaining an all-out war effort until ultimate victory.

PRIORITY REGULATION NO. 16 AMENDED

Measures designed to clarify the appeals procedures that all persons may use in securing relief from regulations, orders or administrative actions were announced by the War Production Board.

In tightening its appeals procedures WPB amended Priority Regulation No. 16 and added Direction 1 to that Regulation to provide for:

(1) More accurate definition of "appeal" as applied to "appeals from administrative actions" as well as "appeals from orders and regulations".

(2) Clear understanding of the distinction between "appeals from orders and regulations" and "appeals from administrative actions".

(3) Methods for filing appeals as well as complete instructions as to what information must be submitted with all appeals.

Previously, in some instances, decisions of a division of WPB on appeals, were considered final. By the changes made in the regulation today all appellants have recourse to the Appeals Board. The only exception is an appeal taken from an action decided upon by the Office of War Utilities, WPB said.

The regulation defines "appeal" as a request for relief from an exceptional or unreasonable hardship which is not suffered generally by others in the same industry or activity. It also applies to a request for relief from apparent discrimination. However, it does not include an initial application or initial request for an authorization, a preference rating, an allocation or any other administrative action expresly contemplated by the orders and regulations of WPB.

"Appeal from administrative action" is defined as one for reconsideration or modification of a WPB action with respect to a particular person. Such administrative actions include the issuance of, or refusal to issue individual authorizations, directives, preference ratings, quotas or allotments.

"Appeal from an order or regulation" is defined as an initial appeal for individual relief from any provision of a published order or regulation (including any published direction, schedule or other supplement to an order or regulation) that applies generally to all persons or to a class of persons described in the order or regulation.

In explaining how appeals must be prepared and filed, WPB said that an "appeal from an order or regulation" should refer to the provision appealed from, and must be filed on Form WPB-1477, unless the order or regulation specifies filing upon some other particular form. An "appeal from administrative action" must (unless otherwise stated in specific instructions) be filed by a letter referring to the action appealed from, and should identify the initial request by WPB form number and case number, if any.

WPB also said that, unless otherwise specified, all appeals must be filed in triplicate.

An "appeal from an order or regulation" must be filed where indicated in the order or regulation. If there is no such indication, the appeal should be addressed "Appeals Routing Unit, War Production Board, Washington, D. C.". An exception to this rule is that a person who, in connection with the subject matter of his appeal, is also making an application on any form that he is instructed to file in a field office may, at his election, attach his appeal to the application and file both with the appropriate WPB field office.

In the case of "appeal from an administrative action" the application should be filed at the same place his initial application or "appeal from an order or regulation" was filed. However, if the administrative action appealed from was based upon neither an application nor an "appeal from an order or regulation" it should be addressed to the Appeals Routing Unit, War Production Board.

WPB's Appeals Board is established as an impartial body primarily to consider second and further "appeals from administrative actions" in cases in which exceptional and unreasonable hardship or discrimination is claimed. The agency said any person complaining of administrative action on these counts may, on a second or further "appeal from administrative action", get his case to the Appeals Board for final action if he expressly requests it in writing.

However, WPB pointed out that the Appeals Board will not normally consider any case which does not involve these factors or which are not second or further "appeals from administrative actions". It is not its ordinary function to review actions involving judgment as to the proper distribution of materials, programming of military or civilian production and their relative essentiality. If the basis for the second or further appeal

CHOOSE

G-E STANDARD SWITCHES and OUTLETS

For Ease of Installation
For Customer Satisfaction

GE2841 Standard single-pole switch. Also GE2516, double-pole; GE2514, three-way; GE2515, four-way. All have brown-colored handles. Similar switches with ivory-colored handles.

GE2679 Standard convenience outlet. Common feed and ground, brown color. Similar outlet in ivory color.

G-E standard switches and convenience outlets are easy to install. Their quality is high and uniform. They have large plaster ears and large binding screws. The switches are completely insulated with Textolite and are "T" rated.

These devices are good looking and will give long service—features sure to please your customers. They can be used equally well in factories, office buildings, homes, etc. for new wiring or wiring replacements.

For further information, see the nearest G-E Merchandise Distributor or write to Section D651-8, Appliance and Merchandise Department, General Electric Co., Bridgeport, Conn.

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GENERAL ELECTRIC

BADGER

Synchronous Automatic **TIME SWITCHES**

for ACCURATE TIMING

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ECONOMICAL OPERATION

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YEARS OF GOOD SERVICE

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● *Prompt delivery on orders rated AA-5 or Higher.*

Type	Poles	Switch Capacity	Case
M1 (Synchronous)	1	50 A. at 125 V.	16 Ga. Steel
M2 "	2	50 A. at 125/250 V.	16 Ga. Steel
RM "	1	50 A. at 125 V.	Cast Iron
RM5 "	2	50 A. at 125/250 V.	Cast Iron

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Patent Applied For
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DAY-BRITE
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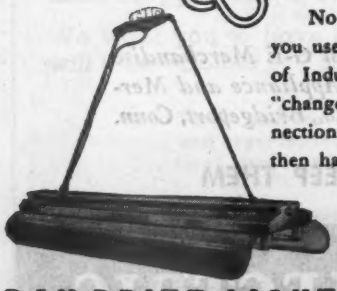
HYDEE *Industrial* FIXTURE HANGER

SAVE DOLLARS ON Maintenance . . . Repairs . . . Operation

No need to center, punch or drill holes when you use the HYDEE Hanger for chain-suspension of Industrial Fixtures — for new installations or "change-over" jobs . . . Simply make wiring connections — screw the hanger to the outlet box — then hang the fixture.

$1.50 LIST PRICE



Complete with two 5-ft. chains, cord clips, "S" hooks and receptacle.
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Nationally distributed through all leading electrical supply houses

is the essentiality to the war effort and not a claim of exceptional and unreasonable hardship or discrimination, no request for referral to the Appeals Board should be made. Members of the Appeals Board are: Dr. Arthur N. Holcombe, chairman; William J. Kerlin, deputy chairman; Ralph Whitehead, Labor Production Office; Lucius Fuller, Civilian Requirements; and Campbell Osborn, Industry Operations.

—Book Review—

ELECTRICAL ESSENTIALS IN MARINE SERVICE

The three volumes of the *Marine Electricians' Library* are written expressly for electricians of all grades. Perhaps some of the introductory material has been too oversimplified for the master electrician, but he is sure to find as he progresses, much valuable information in each volume.

The author makes no attempt at discussing all the problems of marine machines and equipment. There are too many different types and kinds of devices that the electrician may have occasion to install, adjust or repair. Likewise, it is impossible for the author to treat all the aspects of application, maintenance and servicing that the electrician must face while on the job. Instead, an effort has been made to school the electrician thoroughly in the underlying principles which will place him in a position to analyze and solve immediately his daily problems. Since all the various types of equipment share these certain fundamental principles, the author has made a sound approach to the subject.

The contents of Volume I include: Mathematics Review; Physics and Mechanics Review; Generation and the Electric Circuit; Introduction to the Analysis of Alternating Current Circuits and Transformers; Application and Installation of Shipboard Cable; and Marine Telephones and Communication Devices.

The contents of Volume II include: The Electrical Machine, Its Size and Rating; Construction and Characteristics of Alternating-current Generator; Characteristics and Windings of the Direct-current Generator; Operation and Management of Storage Batteries; Circuit Breakers, Switches, Relays, Resistors, Regulators, Governors, and Electrical Devices; Switchboards, Meters, and Instruments; and Installation.

The author of the Marine Electricians' Library is John M. Dodds, field engineer in San Francisco for the General Electric Company and instructor at the University of California.

Volume I is Electrical Essentials in Marine Service, $3.00. Volume II is Electrical Power Sources in Marine Service, $4.00. Volume III is still in press and will be reviewed at a later date. The Library is published by the McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York, N. Y.

DATES AHEAD

Utah Chapter, IAEI—Monthly meeting, Auditorium, Utah Power & Light Co., Salt Lake City, Utah, June 5.

George Washington Chapter, IAEI—Monthly meeting, District Building, Washington, D. C., June 11.

Rocky Mountain Chapter, IAEI—Monthly meeting, Room 385, City and County Building, Denver, Colo., June 12.

Kentucky Chapter, IAEI—Mid Year meeting, Helm Hotel, Bowling Green, Ky., June 21-22.

American Institute of Electrical Engineers—Summer Technical Meeting, Hotel Statler, Detroit, Mich., June 25-29.

National Electrical Contractors Association—Annual conference, Grand Hotel, Mackinac Island, Mich., Sept. 9-15.

International Municipal Signal Association, Inc.—Annual meeting, Hotel La Salle, Chicago, Ill., September 24-27.

MANUFACTURERS NEWS

G-E APPOINTMENTS

Establishment of the air conditioning department as one of the six major operating departments of the General Electric Company has been announced by C. E. Wilson, president of the company. Operations pertaining to heating, air conditioning, and commercial refrigeration have previously been the responsibility of the company's appliance and merchandise department. The new department will have its headquarters at Bloomfield, N. J. and George R. Prout has been named as general manager.

R. C. SOGGE

R. C. Sogge has been named assistant manager of G-E's Central Station Divisions. In addition to his new position, Mr. Sogge will continue as manager of the Customer Division, Central Station Divisions.

B. F. Ilsley has been appointed manager of the G-E Wire and Cable Division, Central Station Divisions. Following his appointment, Mr. Ilsley announced that the Wire and Cable organization would be divided into two sections, the Cable section in Schenectady and the Magnet

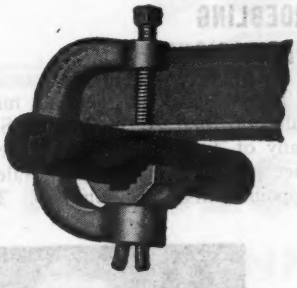
FULLMAN Latrobe PRODUCTS

FULLMAN MANUFACTURING CO. QUALITY LATROBE SUPREMACY LATROBE, PA.

★ FLOOR BOXES ★ WIRING SPECIALTIES

In War Times as in Normal Times Latrobe Products march to Victory

Latrobe Products are easily and quickly installed, economical in cost and without serious competition in quality or length of service. Plan stocks now for the post war period.



No. 470 "Latrobe" Pipe or Conduit Hanger

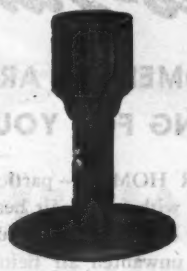
Ever ready and sure grip for hanging pipe or conduit ½", ¾" and 1" to steel beams up to ⅜" thick.

No. 285 "Latrobe" Double Duplex Receptacle Nozzle

Easy to install and highly satisfactory. Nozzle is shown here with No. 200 cover plate.

"Bull Dog" Insulator Support

Used extensively for fastening porcelain or glass insulators to exposed steel framework. Made in four sizes.



No. 280 Nozzle with No. 200 Cover Plate

This ten amp. 250 volt receptacle has brass housing, mounted on ½" brass pipe extension 3" long. Longer pipe extensions available.

No. 110 "Latrobe" Watertight Box

Iron box body, 3½" round brass cover plate. No. 208 receptacle and No. 207 bell Nozzle.

"Bull Dog" BX Cable Staples

These quality staples are still available in cartons, kegs and barrels.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

Blo-Fan

CUSTOMERS ARE WAITING FOR YOU!

POSTWAR HOMES — particularly those with forced air heating and air conditioning — must be rid of unwanted air before it can spread. Greasy vapors, smoke and fumes are unhealthy. They soil draperies and furnishings.

Blo-Fan "Spot" Ventilators eliminate this trouble *at the source!* The patented combination of breeze fan and blower principles gives the Blo-Fan *volume plus power.* Ceiling installed — over the spot where odors and vapors originate — a Blo-Fan is twice as effective as a similar size fan in a side wall across the room.

Blo-Fan

"SPOT" VENTILATOR

offers a new and profitable market for the electrical contractor. Prepare now to sell this No. 1 "must" for new residential work and modernization jobs.

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BRANCHES TO BE REESTABLISHED AFTER THE WAR
SAN FRANCISCO • SEATTLE • CHICAGO • NEW YORK

Wire section in Fort Wayne. Sales managers of the two newly created sections are J. S. Overstreet, Cable, and J. J. Curtin, Magnet Wire. Both men were assistant managers of sales for the Wire and Cable Division before the organization changes became effective.

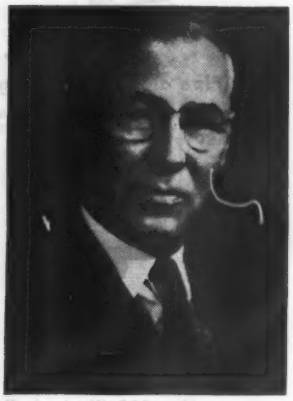
J. E. N. Hume, commercial vice president and manager of the Industrial Divisions, and J. W. Belanger, manager of the Federal and Marine divisions, have been named assistant managers of sales of the Apparatus department. Karl H. Runkle has been named manager of the Industrial divisions to succeed Mr. Hume, and R. S. Neblett has been named Federal and Marine divisions manager to succeed Mr. Belanger.

J. J. Huether has been named assistant manager of the Industrial Divisions and W. A. Wirene manager of the Industrial Materials Division, Industrial Divisions.

E. H. Norling has been appointed sales manager of the sunlamp and heater section at Bridgeport.

ROEBLING PROMOTIONS

Ernest C. Low, general manager of sales of John A. Roebling's Sons Company of Trenton, N. J., has been named vice president in charge of sales. Other appointments are John D. Thompson,



E. C. LOW

works manager, becomes vice president in charge of production; and Charles M. Jones, manager of engineering is now vice president in charge of engineering. Archibald W. Brown, treasurer, has been elected a member of the Board of Directors.

J. N. A. HAWKINS SYLVANIA SALES MANAGER

J. N. A. Hawkins has been appointed general sales manager of Industrial Electronic Products of Sylvania Electric Products, Inc. Mr. Hawkins will have responsibility for products involving applications of electronics to commerce and industry, and will also be concerned with some products in their development stages.

Since 1941 Mr. Hawkins has been en-

Wanted ENGINEERS

Radio
*Electrical
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Materials Handling
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Work in connection with the manufacture of a wide variety of new and advanced types of communications equipment and special electronic products.

Apply (or write), giving full qualifications, to:

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EMPLOYMENT DEPT.

Western Electric Co.
100 CENTRAL AVE., KEARNY, N.J.
*Also: C.A.L.
Locust St., Haverhill, Mass.

Applicants must comply with WMC regulations

CHICAGO EXPANSION NUTS

The Dependable Machine Screw Anchors

For machine screw or machine bolt anchors, it will pay you to specify Chicago Expansion Nuts. These dependable anchoring devices offer the following advantages:

1. Quickly installed—a few hammer taps sets them.
2. Work can be easily dismantled.
3. No part of the anchor projects after removal from floor or wall.
4. Large stock—IMMEDIATE DELIVERIES.

Chicago Expansion Nuts have standard machine screw threads. Available in all sizes from No. 6 up to and including ¾". Setting tool free of charge.

IMMEDIATE DELIVERIES

Write for New Catalog or call your wholesaler.

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J. N. A. HAWKINS

gaged in classified research in Naval Warfare methods and equipment, and has served overseas in Central America, South America, Europe, Africa and Asia.

WESTINGHOUSE CHANGES

Stockholders of the Westinghouse Electric and Manufacturing Company at their recent annual meeting voted to change the company's name to Westinghouse Electric Corporation, for simplicity and brevity.

Gwilym A. Price has been appointed

G. A. PRICE

executive vice president of Westinghouse. Mr. Price will report to Mr. Bucher.

Ellis L. Spray has been elected a vice president of Westinghouse in charge of elevator and air conditioning activities of the Company at Jersey City, N. J. At the same time it was announced that the Westinghouse Electric Elevator Company is being dissolved as a corporate entity and that effective April 1 activities formerly handled by the Elevator Company, which was a wholly-owned subsidiary of the Westinghouse Electric and Manufacturing Company, will continue as the Elevator and Air Conditioning Divisions of Westinghouse.

Lee C. Bennett has been appointed central station manager of the Middle Atlantic District of Westinghouse. Mr. Bennett will also retain the position of marine manager for the Middle Atlantic District and his headquarters will continue to be in Philadelphia, Pa. He succeeds William P. Cochran, who has retired.

Gerard H. Welch has been appointed

MINES WATER SEAL RUBBER CONNECTORS Can Be Molded Onto Any Length Cable

Mines Molded Rubber Electric Cable Connectors can be furnished for attachment to cable right within your own plant or they can be molded to longer, special-length cable in our factory.

Mines Connectors, once molded to electric cable, become a part of the cable itself giving a safe, efficient water seal connector.

Our engineers will gladly work with you in solving portable cable applications. Mines Connectors are available in single or multi-conductor, on capacities up to 5000 volts and 325 amperes.

For efficient, safe, flexible electric power transmission by cable, use Mines Connectors—"The Connector with the Water Seal."

WRITE FOR BULLETIN MC-106, ***showing many successful applications of Mines Connectors throughout industry.***

MINES EQUIPMENT COMPANY

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The SOLDERLESS LUG that Speeds the Job

See that big hex head, slotted screw? You can tighten that up with wrench, pliers, or screwdriver—whichever is at hand.

That screw forces a movable pressure plate down on the wire. No chance for the wire strands to separate. The pressure plate, which is the full length of the barrel, compresses the strands — grips them between large, serrated surfaces which insure a connection that is mechanically strong and electrically efficient.

Yes, you can make fast time when you use this big, strong Solderless Lug. What's more, when you're done, you know the job is right.

A lot of good Electrical Contractors are using this Sherman Lug today. They KNOW that it pays!

H. B. Sherman Mfg. Co.
Battle Creek, Michigan

Sherman
ELECTRICAL CONNECTORS

assistant to the manager of the Switchgear and Control Division of Westinghouse. Mr. Welch has been assistant manager of Switchboard Engineering since last August.

W. E. Lee, formerly of the Los Angeles Application Engineering Department, has been transferred to the Phoenix, Arizona Office as application engineer.

WESTINGHOUSE SUPPLY APPOINTMENTS

R. H. Elliott has been appointed district apparatus and supplies manager of the Middle Atlantic District of the Westinghouse Electric Supply Company. Mr. Elliott moves to Philadelphia from a similar position in the East Central District at Pittsburgh.

William S. Cowan has been appointed Farm sales manager of the Northwestern District of the Westinghouse Supply Company with headquarters at Chicago.

H. E. Bailey has been named district utilities manager for the North Pacific District of Westinghouse Supply, with headquarters in Seattle. In his new position Mr. Bailey will have complete responsibility for the development of all public and private utility business.

•

The Graybar Electric Company, Inc. has announced the opening of a new branch office and warehouse at 1310-12 Agnes Street, Corpus Christi, Texas. R. E. Broyles has been appointed commercial manager in Corpus Christi.

•

The Toledo Pipe Threading Machine Company has named Clemens A. Martus as representative in New England and New York State. His address is 76 Withington Road, Newtonville, Mass. He replaces C. E. Brokaw who was transferred to the Texas territory several months ago.

•

Revere Electric Manufacturing Company recently purchased a large two story structure at 6009-6017 Broadway, Chicago, Ill., and have moved their manufacturing departments and offices to that address.

•

American Steel & Wire Company of Cleveland, has named Robert E. Cramer chief engineer, succeeding E. J. Reardon, who recently resigned.

•

Sterling Electric Motors, Inc. has announced the appointment of Arval Morris as national sales manager.

The "ONE-MAN" HAMMER For TEN-MEN'S WORK

SYNTRON

DEPENDABLE
ELECTRIC HAMMERS

Can SAVE You—
$4.00 every hour they're used —that amounts to $160.00 per week.

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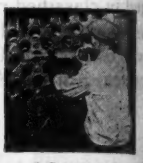
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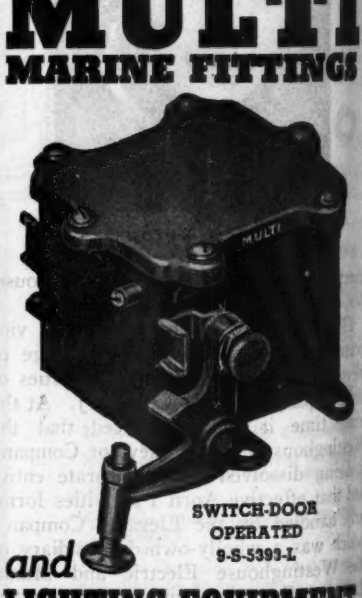

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School Lighting Techniques

[FROM PAGE 77]

assuming room factors of size, and ceiling and wall finishes as fixed.

Maintenance of lighting equipment in schools is generally poor. Incandescent lamp life is one-half to one-third that of fluorescent lamp life. This assures that new incandescent lamps will be installed two to three times as often as fluorescent lamps, providing an opportunity for cleaning the fixture. On the other hand, if school boards contract for maintenance on an annual basis, it may be assumed that the lighting equipment will be cleaned periodically, irrespective of lamp life.

Administrative areas. Indirect lighting is recommended in the lobby and offices. The teachers' lounge can be comfortably lighted with indirect fixtures, or with suitable type floor and table lamps having an indirect component to softly light the ceiling.

Classrooms. Indirect lighting provides glarefree illumination with uniform distribution, which are important and desirable factors for classrooms and laboratories. Most classrooms in existing schools have unilateral daylighting. In such rooms it is desirable to provide flexible switching to control the row of fixtures next to the windows separately. This promotes economy and balanced room illumination. Typical size classrooms, such as indicated in Fig. 1, should be provided with two circuits, for either fluorescent or incandescent lighting. When funds will permit, the circuits adjoining the windows should be automatically controlled by photoelectric control. One such control is adequate for all circuits on the same side of the building. Each classroom should also be provided with convenience outlets to permit projectors and other electrical teaching aid devices to be used. Blackboard lighting should be used in large classrooms.

Manual training classrooms and workshops may be successfully lighted with industrial type direct lighting reflectors.

Circulation areas. Direct lighting is recommended for corridors, passageways, stairways and entrances. Flush mounted units, or prismatic or enclosing glassware surface mounted units provide a good type of fixture for these areas.

Auditorium. Architectural and structural details will influence the selection of the lighting equipment for the general illumination in the auditorium. Provision should be made for flexibility

[Continued on page 190]

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in lighting intensities, either by multiple switching or by dimmer control. Borderlights or stage spotlights and floodlights should be provided for stage lighting. Disappearing type footlights should be installed in the large stages.

Library. Indirect lighting is desirable.

Gymnasium. Direct incandescent lighting has been used quite successfully for lighting gymnasiums economically, and adequately. Medium spread distribution type reflectors are usually employed. Various other lighting techniques have also been used, some with satisfactory results. The lighting for each gymnasium should be considered as a separate problem and a solution worked out to provide uniform diffused lighting based on the various factors involved.

Alternate Lighting Techniques

In all cases where indirect lighting has been recommended, the bowl or trough of the equipment may be luminous, or translucent, permitting up to ten percent distribution of light below the horizontal. This eliminates the objection of a dark object overhead. Light colored finishes on opaque bowls or troughs achieve practically the same result. The use of indirect lighting, to be economical, requires a good maintenance schedule. For this reason, alternate techniques which are affected less by poor maintenance may be more appropriate for many areas in the school.

Shielded direct fluorescent lighting with lamps exposed to the work area provides fairly satisfactory lighting results only when the average general illumination intensity is approximately 50 footcandles. With lower intensities reflected glare from the exposed lamp sources becomes objectionable.

Semi-direct or direct-indirect lighting fixtures will in most cases provide the maximum quantity of illumination based on a specific generated lumen output, as compared with indirect illumination. These fixtures, properly designed, also provide shielding of the light source; however, direct and reflected glare will be greater than with indirect lighting fixtures. These fixtures also present approximately the same maintenance problem as do indirect fixtures. It is for these reasons that many school codes set a brightness limit, usually two candlepower per square foot, on such equipment. Again, this is a regulatory code, establishing a limiting factor. Certainly the desirable result is somewhere beyond the code limit.

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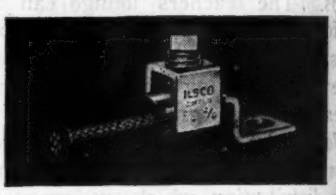

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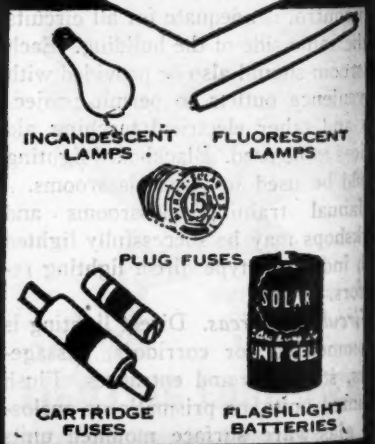

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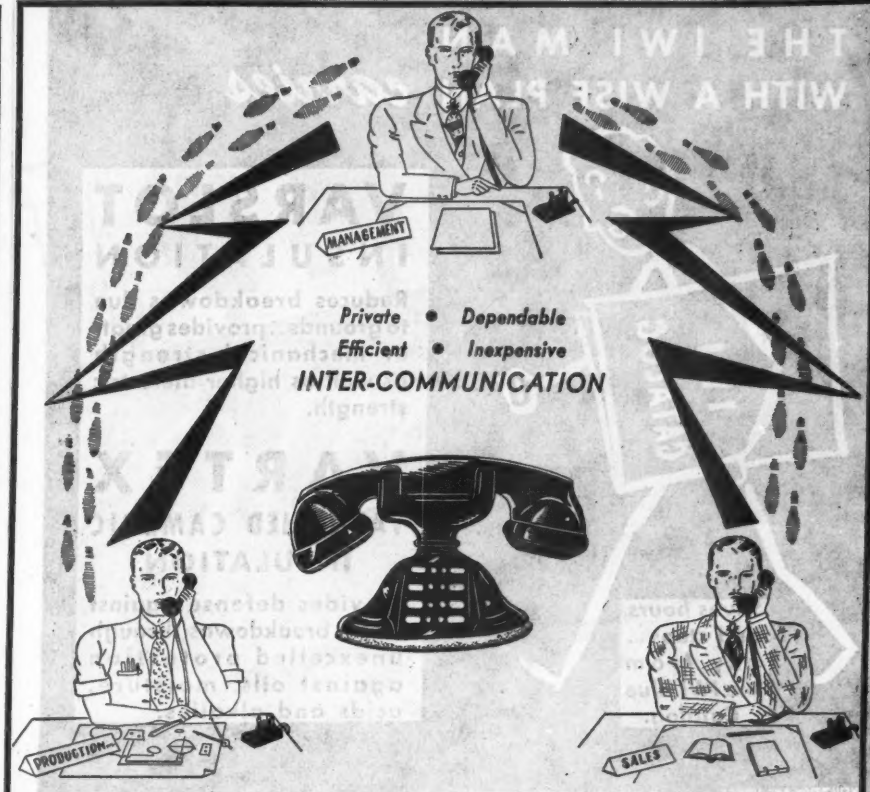

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"RESTRICTIONS LIFTED on the MANUFACTURE and SALE of INTERCOM TELEPHONE EQUIPMENT"

In the May issue of Electrical Contracting AUTH offered to help Mr. Frustrated and thousands like him to secure Intercom Telephone systems. At that time restrictions on the manufacture and sale of telephone equipment were still in effect.

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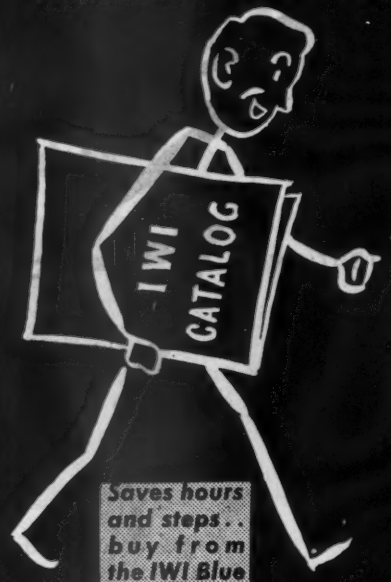

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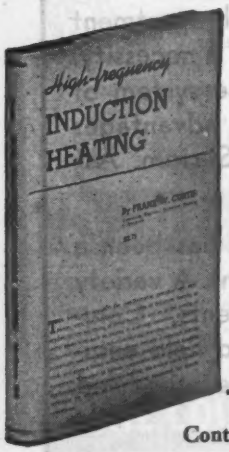

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D-C and A-C Load Center Distribution

[FROM PAGE 41]

closing. Since the d-c breaker is connected directly to the 250 v. bus, direct current is applied to the motor windings, bringing the motors to a complete stop before reversing current is applied.

Single conductor and multiple conductors are used depending on circumstances.

Another part of the project which was outstanding both from the standpoint of results and contractor know-how, was the conversion of the two Plate Mill motors from 2300 volt 25 cycle to 6900 volt 60 cycle. Both of these motors are now rated 2500 hp., 251 rpm., and are used to drive a 3-stand mill. Because an extended outage could not be tolerated, the conversion job was carefully engineered and many times rehearsed before "opening night." A total of 12 days was required for preparation; and the elapsed time, from the very second the 2300 volt 25 cycle rotor stopped until the 6900 volt 60 cycle rotor started was exactly 40 minutes.

The electrical preparations included temporary 2300 volt circuits with provisions of cut over to the 6900 volt permanent feeders.

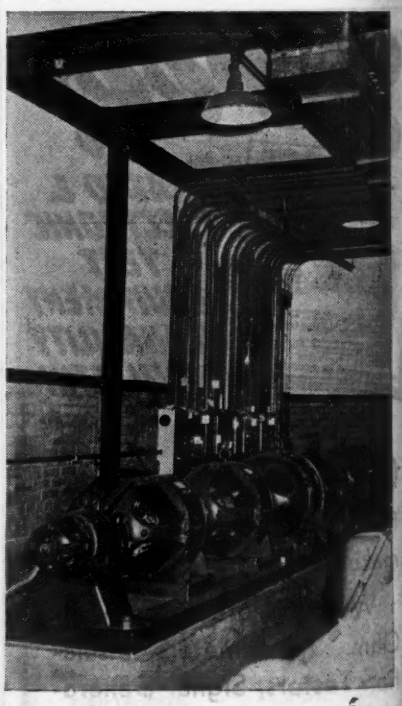

FIG. 12—Still under construction at the time this shot was taken, the above photo shows the "heart" of the Blooming Mill drive control. This battery of motor-generators-exciters provides precise control of the rolling mill stand speed. The mill operator sets his dial controls and this amplidyne motor-generator unit does the rest automatically and with great precision.

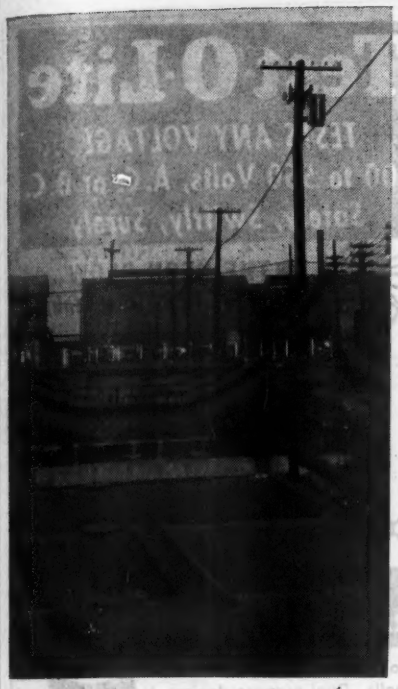

FIG. 13—Pole line carries two 6900 volt circuits; one to the Open Hearth rectifier (from No. 18 breaker in Fig. 2) and the other for miscellaneous power and light (from breaker No. 19). The transformer which hangs on the pole in the foreground is a single phase lighting tub rated 50 kva. 6900/220/110 v. and is shown in Fig. 2 as transformer 53. The heavily loaded pole line on extreme right is the 250 volt tie-circuit running to the Open Hearth plant, d-c substation.

The mechanical preparations included knocking-out the wall (see Fig. 9), setting 2–25 ton chain hoists for removing bearing stand and lifting split stator, packing shaft in dry-ice, and heating new rotor spider to 105° C. At the appointed hour, bolts were being loosened before the rotor had even idled to standstill. As soon as the old rotor could be removed from the stator, the spider was cut from the shaft by acetylene torch. The dry ice had produced a shaft shrinkage of 0.0175 in. An expansion of 0.026 in. was obtained by heating the new rotor. This total clearance permitted easy assembly with the assistance of a 5 ton chain hoist. Part of the preparation included a 200 ton hydraulic ram, but use of it was not required.

All of this work was started and brought to essential completion under the Alan Wood organization, consisting of H. C. Miller, Chief Engineer; A. D. Howry, Electrical Engineer; and John W. Deimler, Project Engineer. All of the construction work was under the direct supervision of Clark Adams, Superintendent of the Utilities Engineering Company of which Howard L. Miller is President.

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Tax Carry-Over and Carry-Back

[FROM PAGE 79]

ufacture of a new product or the performance of a new function will be common. Most frequent question from those anticipating this development is, "Should I organize a new corporation, form a partnership or continue to operate through the old corporation?"

While no pat answer can be given to this type of question, it will usually be advisable, taxwise, to continue with the old corporation. Starting any new business, especially in the uncertain times ahead, carries with it the danger of a loss, or at least low income, in the initial stages of development. A shift to a new corporation or a partnership means the loss of a carry-back to the high war taxes paid by the original corporation. True, there is still the possibility of the carry-overs. But there is no assurance that the new business will ever prosper or prosper in time (within three years) to take full advantage of initial losses.

RIA Observation: **A shift from a partnership to a corporation also means a change of taxpayer and therefore a loss of the right to a carry-back refund of taxes paid by the partnership.**

Carry-Backs and Your Investments

In buying securities for investment or speculation, consider the carry-back position of the corporation whose stock you wish to purchase. For example, corporations which are normally marginal or sub-marginal producers but which have been earning substantial profits during the war should receive particular consideration because of their advantageous carry-back position. If such a corporation's invested capital or 1936-39 earnings were high, thus giving it a large EPT credit, it would have still another advantage. Whereas a more economical producer (whose securities are usually sold at a higher price) would probably have neither losses nor subnormal earnings during the early postwar period, the marginal or sub-marginal producer may recoup a substantial portion of its war taxes via the loss and unused EPT credit carry-backs.

RIA Recommendation: **Even "blue chip" companies should be eyed with a view to their EPT credit and therefore their unused EPT credit carry-back potential. Many excellent companies have such a large invested capital that they cannot expect to earn anywhere near their EPT credit in normal times.**

(Continued on page 196)

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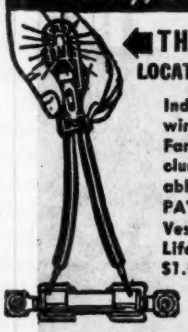

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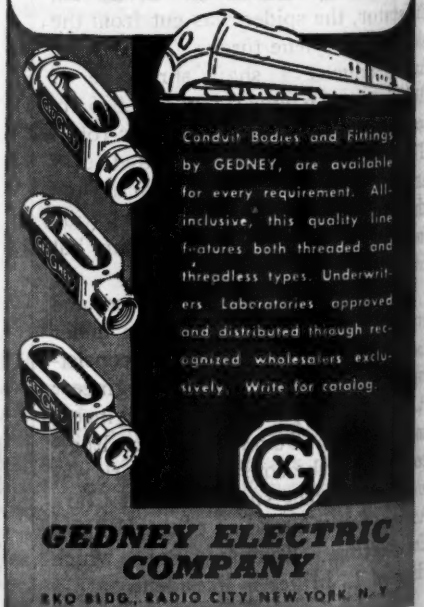

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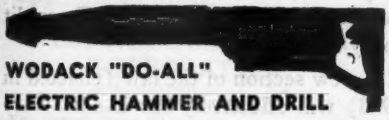

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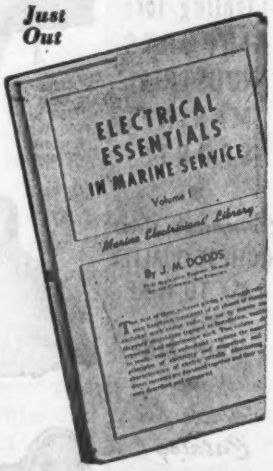

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Most Tax Devices Based on Carry-Overs and Carry-Backs Are Out

The Treasury has found an antidote to most of the tax avoidance schemes based on carry-overs and carry-backs. The three most common are mentioned here by way of warning.

1. An individual is planning to go into a profitable business. He purchases a corporation formerly engaged in an unrelated business which has no net worth but which sustained a substantial loss in the previous year. He operates his profitable business through the corporation in the expectation that he will be able to use the loss carry-over to offset all or a portion of its otherwise currently taxable income.

2. A corporation has been paying high war taxes. It transfers a profitable portion of its business to a new corporation which it has organized. It retains the portion which is not profitable but which it wishes to continue. The idea is to establish losses or at least unused EPT credits to obtain a refund of the war taxes paid.

3. A corporation is organized in 1941 to engage in war work. In 1946 its war contracts are terminated and there is no further business reason for the enterprise to continue. However, instead of dissolving, the corporation stays in existence to get refunds through loss or unused EPT credit carry-backs.

A new section of the law (enacted in 1943) will effectively bar almost every attempt to utilize the first two devices. Section 129 permits the Commissioner to eliminate the tax benefit from the acquisition of a corporation where it is done primarily for tax avoidance. The third device will probably also be made ineffectual by Congress or by the courts. This leads to the converse proposition that unless a corporation does engage in some bona fide business activity, it will *not* be recognized. Possibly other more specific requirements will be added by Congress to insure that corporations will not be kept in existence merely to receive refund checks from the Treasury.

RIA Observation: **There is no bar to obtaining a tax benefit by way of the carry-overs or carry-backs even though it comes about through the acquisition of a corporation or property *provided the principal purpose of the transaction is to achieve a business end.* For example, suppose that under situation (1) the corporation has a heavily mortgaged plant which is particularly suitable for the purchaser's prospective product. The acquisition of a desirable plant could conceivably be the**

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principal purpose behind the transaction. The fact that the carry-back benefit makes the deal more attractive is immaterial.

How Soon Can You Get a Refund?

Probably the greatest defect in the carry-backs is the length of time it takes to receive your refund. While business generally appears to be in a healthy financial condition, there are still many companies that must rely on carry-back refunds to finance necessary reconversion and deferred maintenance expenses. Recognizing the problem, the Treasury has proposed a partial remedy which will probably be adopted. The suggested procedure would be roughly as follows:

A corporation which generally pays its tax for the preceding year in quarterly instalments would be allowed to estimate its expected income or loss for the current year. On the basis of that estimate, it could file a tentative claim for refund based on the anticipated carry-backs. The Treasury would then allow it to apply the tentative refund against the quarterly instalments coming due. An adjustment would be made when the year is completed and the actual results are known. This procedure would ease the financial strain of paying taxes in a loss year on income earned in the previous year.

RIA Observation: **This suggested procedure would not apply to partnerships or proprietorships, since they are already on a current payment basis.**

What Are the Chances of Repeal?

So far as the *carry-OVER* is concerned, there seems to be no real chance of repeal. In fact, the carry-

[Continued on Page 198]

W. L. GAFFNEY, Tacoma, Northwestern Section IAEI secretary, H. G. Ufer, Underwriters Laboratories, Los Angeles, and J. Hyde Stayner, Utah Power & Light, Salt Lake City, past president of the Northwestern Section.

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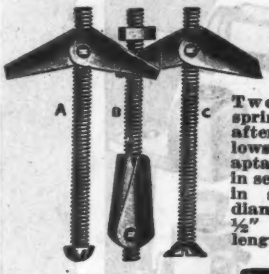

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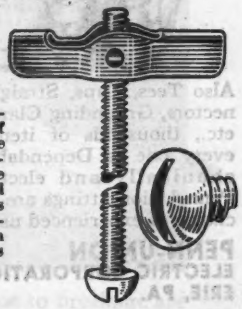

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over period will probably be extended to four or even five years as a post-war incentive to private enterprise.

While less certain than the carry-overs, it appears that the *carry-BACKS* (both loss and unused EPT credit) will be retained, but probably for only two years after the war. The administrative problems incident to the carry-backs, plus the budget difficulties created when no accurate estimate of subsequent refunds can be made, weigh heavily against the carry-backs as a permanent feature of our tax system. But top Treasury and Congressional officials feel that a commitment has been made to taxpayers to keep the carry-backs for at least two years after the war as a substitute for post-war reserves. Current thought is not to make this two-year carry-back dependent on whether or not the excess profits tax survives the war.

While the retention of the *carry-BACKS* for the two years appears highly probable, it is not a certainty. Opposition has come not only from some "liberal" and labor groups (although labor generally seems now to have become more favorably disposed toward the carry-backs), but also from many others more conservatively inclined. For example, executives of a number of soundly financed, old, established firms have raised two objections.

1. The carry-backs give a competitive advantage to the marginal and sub-marginal producer as well as to a new competitor born of the war.

2. While the objecting companies will receive no tax benefits from the tax carry-backs, substantial refunds (possibly two or three billions) will be paid to other taxpayers. These sums must be made up in taxes. As a result Congress may have to refrain from cutting corporate income tax rates after the war. Therefore, many an old, established company is fearful that, in effect, it will have to pay for the carry-back refunds to less profitable business.

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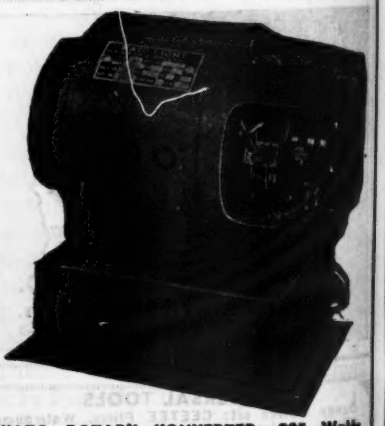

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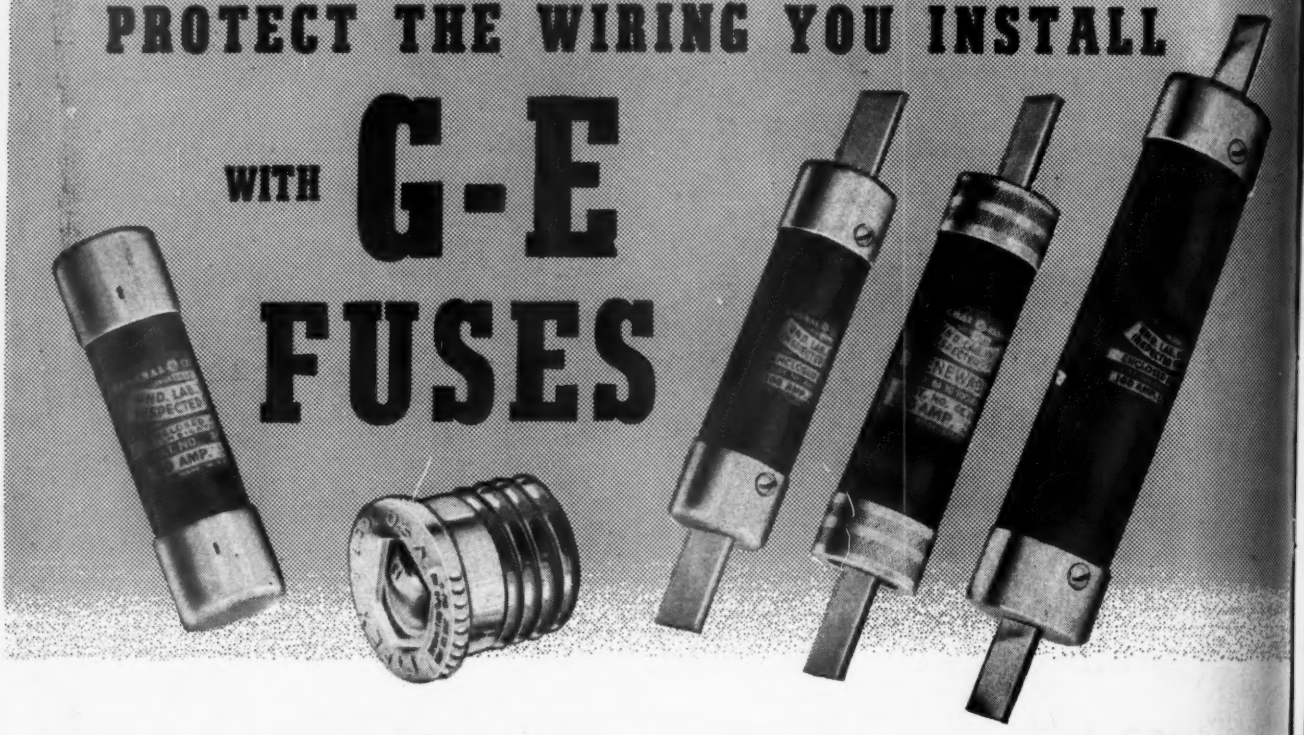

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